

**SECOND SUPERFUND FIVE-YEAR REVIEW REPORT  
GEIGY CHEMICAL SUPERFUND SITE  
ABERDEEN, MOORE, COUNTY, NORTH CAROLINA  
EPA ID: NCD 981 927 502**



Prepared by  
The U.S. Environmental Protection Agency, Region 4  
Atlanta, GA

With the Assistance of  
North Wind, Inc.  
On behalf of  
Olin Corporation and Syngenta Crop Protection

September 2008



10589511

## Executive Summary

This report documents the second five-year policy review of the Geigy Chemical Corporation Superfund Site located in Aberdeen, Moore County, North Carolina. The Site was added to the National Priorities List (NPL) in October 1989 and the EPA identification number for this Site is NCD 981 927 502.

The Geigy Chemical Corporation (Aberdeen Plant) was a pesticide formulation/blending/retail sale facility operated from 1947 to 1989 by several companies. The Site (the source area) is approximately one (1) acre in size. The following chemicals (pesticides) were identified as contaminants of concern (COCs) for the Site: aldrin, benzene hexachloride (BHC) isomers, chlordane isomers, dichlorodiphenyldi-chloroethane (DDD), dichlorodiphenyldichloroethylene (DDE), dichlorodiphenyltrichloroethane (DDT), dieldrin, endrin, and toxaphene.

Three removal actions focusing on soil contamination have been conducted at the Site. The first two, conducted in 1989 and 1991, removed approximately 3,300 tons of visibly contaminated soil and debris from the Site. Following the preparation and finalization of the Remedial Investigation/Feasibility Study (RI/FS), a Record of Decision (ROD) was signed on August 27, 1992. The RA (the third removal action) implemented by the ROD included demolition of the former warehouse foundation; excavation of the top foot of on-site soils contaminated above performance standards; off-site disposal of excavated soils as appropriate; extraction of groundwater from the surficial and Upper Black Creek aquifers; treatment of extracted groundwater via carbon adsorption; Site restoration; and further sampling and analysis of the Upper Black Creek aquifer to determine extent of pesticide contamination and determine if TCE found in two wells was site-related.

The Remedial Action (RA) was implemented from September 1996 to February 1997 and included the removal of concrete foundations and other debris totaling approximately 2,460 tons to a Subtitle D landfill; disposal of 4,475 tons of contaminated soils to a Subtitle C landfill; and the construction/ installation of groundwater extraction wells and a groundwater treatment facility with infiltration galleries for the discharge of treated groundwater. The groundwater treatment system began operation in January 1997 and as of July 2008 approximately 82 million gallons of extracted groundwater from the surficial and Upper Black Creek aquifers have been successfully treated.

As required by the 1992 ROD, a downgradient investigation was conducted to determine the extent of pesticide plumes in the Upper and Lower Black Creek aquifers. The results of this investigation were reported in the 1997 *Downgradient Groundwater Remedial Action Work Plan (RAWP)*, and the recommendations therein, were adopted by EPA through the issuance of the January 1998 Explanation of Significant Difference (ESD). The ESD established that the downgradient groundwater contaminant plume would be monitored as part of the overall Site remedy (i.e., monitored natural attenuation (MNA)). The ESD also established the groundwater cleanup goals for the following COCs detected in the groundwater in the downgradient area: for alpha-, beta-, and delta-BHC the cleanup goal was set at 0.05 µg/l (micrograms per liter) and for gamma-BHC the cleanup goal was set at 0.20 µg/l. Based on modeling results, the concentrations of these COCs in the downgradient area should decline to the cleanup goal concentrations in 25 years (i.e., in 2022).

The 2003 Five-Year Review report made the following three (3) recommendations: 1) delete the 1992 ROD requirement for fencing and signage as the soil cleanup phase successfully removed any unacceptable risk to human health or the environment via direct contact to contaminated soils; 2) update the State of North Carolina issued Site groundwater remediation permit; and 3) identify the off-site source of the trichloroethene (TCE) being detected in the groundwater at the Geigy Site.

The Agency still needs to enact the appropriate administrative paperwork (i.e., issued an ESD) to accomplish Item #1. Item #2 has been completed. As for Item #3, in August 2008, EPA initiated a RI/FS at a new Superfund Site called Aberdeen Contaminated Groundwater Site that is located upgradient of the Geigy Site and is believed to be the source of the TCE.

The remedy at the Geigy Site is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals noted in the 1992 ROD as amended through the 1998 ESD through continued MNA and groundwater pump and treatment. The selected remedy at the Site is protective of human health and the environment in the short term, because all exposure pathways that could result in unacceptable risks are being controlled.

However, in order for the remedy to be protective in the long term, the following actions need to be taken: restrictive covenants, well drilling ordinances, or other enforceable institutional controls that prevent the installation of a potable well must be implemented at properties impacted by contaminated groundwater above the groundwater cleanup goals for Site related COCs.

**SECOND FIVE-YEAR REVIEW SUMMARY FORM**

**SITE IDENTIFICATION**

**Site Name:** Geigy Chemical      **EPA ID:** NCD 981 927 502  
**Region:** 4      **State:** North Carolina      **City/County:** Aberdeen/Moore

**SITE STATUS**

**NPL Status:**     Final     Deleted     Other (Specify) \_\_\_\_\_  
**Site Lead:**     Fund     PRP  
**Remediation status** (choose all that apply):     Under construction     Operating     Complete  
**Multiple OUs?:**     Yes     No      **Construction completion date:** July 20, 1998  
**LTRA:**     Yes     No      **Has site been put into reuse?**     Yes     No

**REVIEW STATUS**

**Lead Agency:**     EPA     State     Tribe     Other Federal Agency \_\_\_\_\_  
**Review Period:** December 2007 to August 2008    **Date(s) of Site Inspection:** April 2, 2008

**Who conducted the review (EPA Region, state, Federal agencies or contractor):**  
 EPA-Region 4, North Carolina Department of Environment & Natural Resources, North Wind, Inc. on behalf of the Potentially Responsible Parties, and Representatives from the Performing Settling Defendants

**Type of Review:**     Statutory     Policy  
                            Post-SARA     Pre-SARA     NPL-Removal only     Regional Discretion  
                            Non-NPL Remedial Action Site     NPL State/Tribe-lead

**Review Number:**     1 (first)     2 (second)     3 (third)     Other (specify) \_\_\_\_\_

**Triggering Action:**  
 Actual RA Onsite Construction at OU # \_\_\_\_\_     Actual RA Start at OU# \_\_\_\_\_  
 Construction Completion     Previous Five-Year Review Report (September 25, 2003)  
 Other (Specify) \_\_\_\_\_

**Recycling, reuse, redevelopment site:**     Yes     No

**Due Date** (five years after triggering action date): September 25, 2008

**Issues:**  
 Institutional Controls  
 Re-Evaluate Timeframe to Achieve Groundwater Performance Standards  
 Re-Evaluate Capture Zone Analysis for the surficial and Upper Black Creek aquifer groundwater extraction systems  
 Revise Monthly Inspection Report Form

SECOND FIVE-YEAR REVIEW SUMMARY FORM

**Recommendations:**

Institutional Controls

Re-Evaluate Timeframe to Achieve Groundwater Performance Standards

Re-Evaluate Capture Zone Analysis for both the surficial and Upper Black Creek aquifer groundwater extraction systems

Revise Monthly Inspection Report Form to communicate findings on monthly windshield surveys of offsite properties

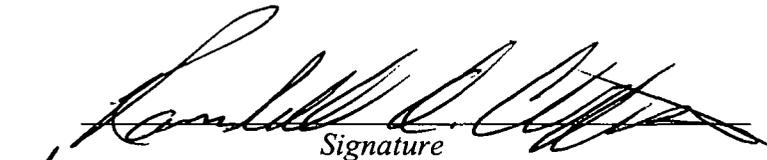
**Protectiveness Statement(s):**

The remedy at the Geigy Chemical Corp. (Aberdeen Plant) Site is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals noted in the 1992 Record of Decision as amended through the 1998 Explanation of Significant Difference through continued monitored natural attenuation and groundwater pump and treatment. The selected remedy at the Site is protective of human health and the environment in the short term, because all exposure pathways that could result in unacceptable risks are being controlled.

However, in order for the remedy to be protective in the long term, the following actions need to be taken: restrictive covenants, well drilling ordinances, or other enforceable institutional controls that prevent the installation of a potable well must be implemented at properties impacted by contaminated groundwater above the groundwater cleanup goals for Site related chemicals of concern.

**Other Comments:** None

Approved by:

  
Signature  
Franklin E. Hill, Director  
Superfund Division

  
Date

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**List of Acronyms**  
**Geigy Chemical Superfund Site**  
**Aberdeen, NC**

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ADI	Acceptable Daily Intake
amsl	above mean sea level
AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
BHC	Benzene Hexachloride
CAS	Chemical Abstract Service Registry Number
COC	Chemical of Concern
CSM	Conceptual Site Model
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
CRQL	Contract Required Quantitation Limit
CWA	Clean Water Act
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DA	disposal areas
EA	Endangerment Assessment
EI	Environmental Indicator
EMP	Employment District
EPA	United States Environmental Protection Agency
ESD	Explanation of Significance Difference
FR	Federal Register
FS	Feasibility Study
GIS	Geographic Information Systems
gpm	gallons per minute
GPRA	Government Performance Results Act
GRL	Groundwater Remediation Level
HNu	Photo ionization analyzer
HRS	Hazard Ranking System
HSL	Hazardous Substance List
HSMP	Holistic Site Management Plan
HSP	Health & Safety Plan
HSWA	Hazardous Solid Waste Amendments
HWS	Hazardous Waste Section
IRIS	Integrated Risk Information System
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
MNA	Monitored Natural Attenuation
MRL	method reporting limit
MW	Monitoring Well
NAAQS	National Ambient Air Quality Standards

**List of Acronyms**  
**Geigy Chemical Superfund Site**  
**Aberdeen, NC**

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NC	North Carolina
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
ND	Not Determined
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
PCOR	Preliminary Closeout Report
PMCLG	Proposed Maximum Contaminant Level Goal
POP	Project Operations Plan
POTW	Publicly Owned Treatment Works
ppb	parts per billion
ppm	parts per million
PRP	Potentially Responsible Party
PSDs	Performing Settling Defendants
RA	Remedial Action
RAO	Remedial Action Objectives
RAWP	Downgradient Groundwater Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RD/RA	Remedial Design/Remedial Action
R <sub>f</sub> D	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSD	Risk Specific Dose
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SRL	Soil Remediation Level
TAL	Target Analyte List
TBC	To Be Considered
TCE	Trichloroethene
TCL	Target Compound List
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage and Disposal
UAO	Unilateral Administrative Order
µg/l	micrograms per liter
µg/kg	micrograms per kilogram
USC	United States Code
VOC	Volatile Organic Compound
WNCRAQA	Western North Carolina Regional Air Quality Agency

# Geigy Chemical Corporation Superfund Site Aberdeen, Moore County, North Carolina Second Five-Year Review Report

## 1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) Region 4 has conducted the second five-year review of remedial actions implemented at the Geigy Chemical Corp. (Aberdeen Plant) Superfund Site in Aberdeen, Moore County, North Carolina (NC). This review was conducted by the Remedial Project Manager (RPM) from December 2007 through September 2008, with input from North Carolina Department of Environment and Natural Resources (NCDENR). This report was prepared with the assistance of North Winds, Inc. on behalf of the Performing Settling Defendants (PSDs) for the Site (Olin Corporation and Syngenta Crop Protection) in accordance with applicable EPA guidance. While the PSDs and PSD's contractor provided data for this five-year review, EPA, as the lead agency overseeing Site activities, managed the preparation of the Five-Year Review, prepared the protectiveness statement and finalized the Five-Year Review Report. The Potentially Responsible Parties (PRPs) for the Geigy Superfund Site include Syngenta Crop Protection (successor to Novartis Crop Protection which was the successor to Ciba-Geigy Corporation), Olin Corp, Kaiser Aluminum & Chemical Corp, Lebanon Chemical Corp, Aberdeen and Rockfish Railroad, and Columbia Nitrogen Corporation.

The purpose of five-year reviews is to determine whether the remedy at a site is or is expected to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in five-year review reports. In addition, five-year review reports identify issues found during the review, if any, and recommendations to address them.

This review is a policy review. EPA must implement five-year reviews consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substance Contingency Plan (NCP). CERCLA § 121(c), as amended states:

*If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The NCP part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

*If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and*

*unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

Although not required by statute, this review is being conducted in accordance with EPA policy. EPA conducts five-year reviews as a matter of policy at: (1) sites where no hazardous substances will remain above levels that allow unlimited use and unrestricted exposure (uu/ue) after completion of remedial actions, but the cleanup levels specified in the Record of Decision (ROD) will require five or more years to attain; (2) sites addressed before Superfund Amendments and Reauthorization Act (SARA) at which the remedy, upon attainment of cleanup levels, does/will not allow unlimited use and unrestricted exposure; and (3) removal-only sites where hazardous substances remain on-site at levels that will not allow unlimited use and unrestricted exposure. This site has been reviewed because cleanup levels for contaminants in the groundwater will require more than five years to attain.

This is the second five-year review of the Geigy Chemical Corp. (Aberdeen Plant) site. The Site has been identified as requiring a "policy" five-year review, which must occur every five years after completion of construction until cleanup levels set in the ROD are attained. Completion of construction, as designated by signature of the Preliminary Close-Out Report (POCR) occurred on July 20, 1998. The first Five-Year Review was approved by EPA on September 25, 2003. According to the Comprehensive Five-Year Review Guidance, subsequent reviews are required within five years of completion of the prior review. Therefore, this second review is due to be completed by September 25, 2008. The next (third) five-year review for this Site will be due five years after the signature date for this five-year review.

The Site has one operable unit (OU) that will be discussed in this report. The one operable unit addresses soil, surface water and groundwater contamination at the Site. Several removal and remedial actions have been completed at this Site and groundwater remediation and monitoring activities are ongoing.

This review will be placed in the EPA site files and local repository for the Geigy Chemical Corp. (Aberdeen Plant) site. The local repository is located at the Aberdeen Town Hall, 115 N. Poplar St., Aberdeen, NC 28315 and EPA's, Region 4 Information Center at 61 Forsyth Street, Sam Nunn Atlanta Federal Center, Atlanta, Georgia 30303.

## 2.0 SITE CHRONOLOGY

Table 2-1 lists the chronology for selected events for the Geigy Site, as shown below.

<b>EVENT</b>	<b>DATE</b>
Site leased by several companies for pesticide formulation and retail sales	1947 to 1989
EPA detected pesticides in surface and subsurface soils on the site	January 1987
Site inspection conducted by the State of North Carolina	March 1987
Preliminary site assessment	June 1987
Hazard Ranking System evaluation	August 1987

<b>Table 2-1: Chronology of Events</b>	
<b>EVENT</b>	<b>DATE</b>
Site proposed to be listed on the National Priorities List	June 1988
Administrative Order on Consent signed	December 16, 1988
Site added to National Priorities List	October 4, 1989
PSDs conducted a soil removal action. 462 tons of soil and debris removed	February 23 1989 to December 16, 1989
Second soil removal action by PSDs. 2,841 tons of soil and debris removed	February 25, 1991 to June 1, 1991
Human Health Risk Assessment and Ecological Risk Assessment completed	March 13, 1992
PRP preparation of Remedial Investigation and Feasibility Study	December 16 1988 to August 27, 1992
Record of Decision signed	August 27, 1992
Consent Decree for PSDs to conduct remedial design/remedial actions	July 15, 1993
Remedial Design Start	July 15, 1993
Remedial Design Completion	March 1996
Remedial Action contract for construction of groundwater remediation system and removal of contaminated soil and debris awarded by PSDs	September 1996
Pre-final inspection of soil remediation by EPA and State of North Carolina	January 15, 1997
Groundwater Remediation System operational	January 1997
Final inspection of soil remediation by EPA and State of North Carolina	February 26, 1997
Downgradient Groundwater Remedial Action Work Plan approved by EPA and North Carolina Department of Environment and Natural Resources	November 1997
Explanation of Significant Differences issued by EPA	January 1998
Preliminary Close-Out Report	July 20, 1998
Additional monitoring well installation	April 1998
ATSDR releases Public Health Assessment report for Geigy Site	August 16, 2001
Site inspection for the first five-year review	February 18, 2003
First Five-Year Review Report	September 25, 2003
Site inspection for the second five-year review	April 2, 2008

### 3.0 BACKGROUND

#### 3.1 PHYSICAL CHARACTERISTICS

The Geigy Chemical Corp. (Aberdeen Plant) is located just to the east of the corporate limits of Aberdeen, North Carolina in southeastern Moore County (**Figure 3-1**). The Site is located on the Aberdeen and Rockfish Railroad right-of-way adjacent to Highway 211 and forms an elongated triangle with the highway and railroad forming the apex.

The Geigy Site encompasses an area of approximately one acre (the source area) that has been graded to be mostly level in nature (**Figure 3-2**). The Site has topography typical of the Upper Coastal Plain physiographic region, with shallow water tables and low topographic relief. Soils in the area are classified as the Candor sand type that overlays unconsolidated sandy to clayey sediments. There are also an intermittent clay zone and several other clay lenses that divide the surficial groundwater aquifer from the Upper and Lower Black Creek aquifers in the area.

Drainage from the Site and predominant groundwater flow is to the west and northwest with both surface and subsurface runoff entering McFarland's Branch, Ray's Mill Creek, and Aberdeen Creek. Both McFarland's Branch and Ray's Mill Creek empty into Aberdeen Creek.

### 3.2 LAND AND RESOURCE USE

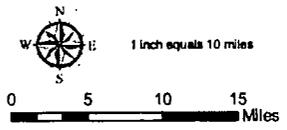
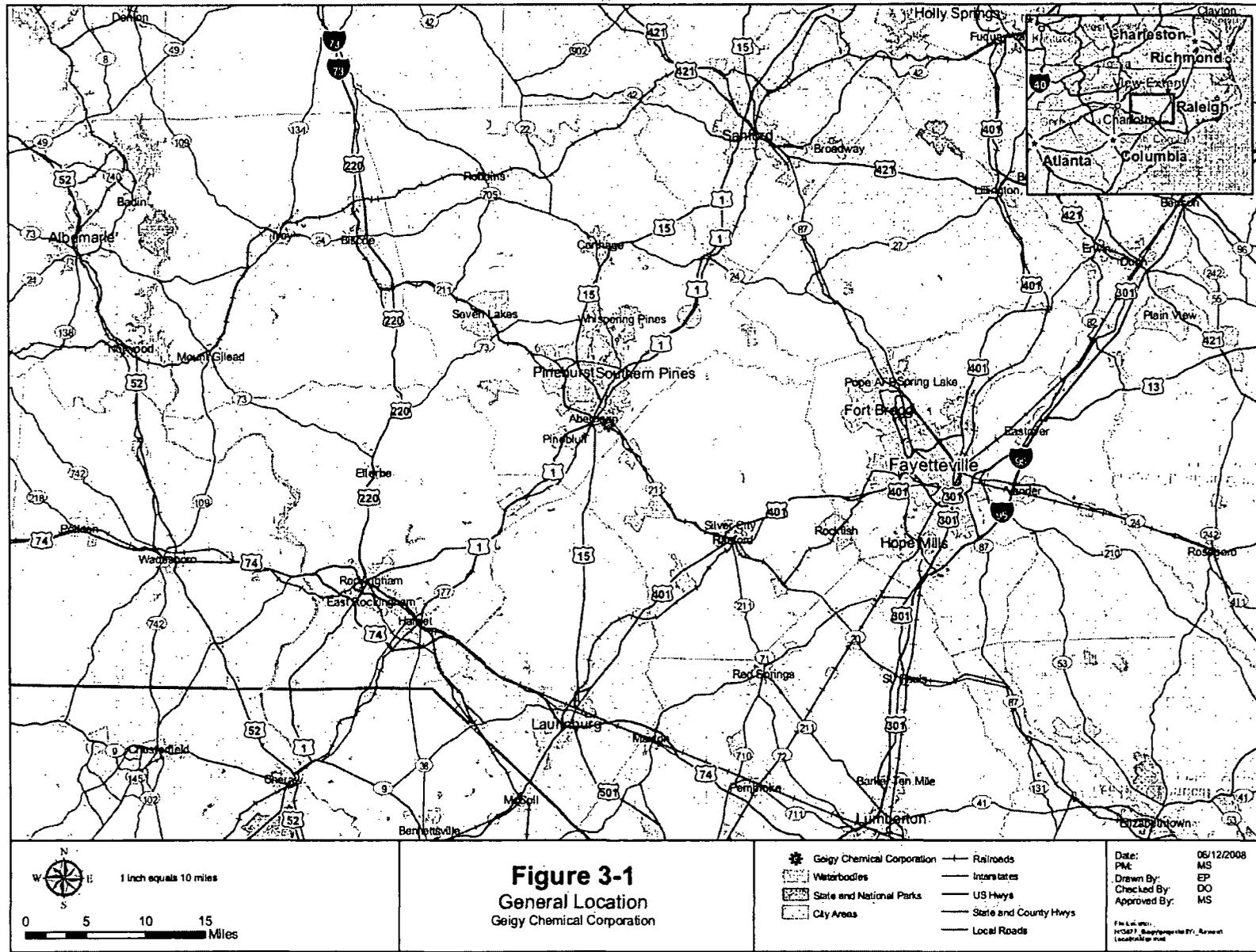
The Geigy Site is situated on the right-of-way of a rail line operated by the Aberdeen and Rockfish Railroad. The property is in the shape of an elongated triangle bounded by Highway 211 to the north and the Aberdeen and Rockfish Railroad line to the south, with the highway and railroad intersecting at the apex of the triangle. Domino Drive, a private road that connects to Highway 211 and is used to access residential properties south of the Site, transects the eastern portion of the parcel. The parcel is owned by the Aberdeen and Rockfish Railroad, however, the PSDs maintain this property as part of their management of the Site. The Site property is not in use and is vegetated with grasses and a light mixture of pine trees and small ornamental trees. Commercial business properties border the Site property on the north side of Highway 211, and to the west. Residential properties and undeveloped woodlands border the Site property to the east and south.

When the ROD was issued in 1992, the Site property was no longer in use as a facility to blend and distribute agricultural chemicals and was inactive. The remnants of several structures used for blending and retail operations were present at the Site at that time, including the former warehouse foundation, a small office building/scale house, several above ground storage tanks, and the former bathhouse foundation. These structures were removed as part of the Site remedy.

The PSDs lease an adjoining land parcel, located south of the rail line, which includes the treatment building, groundwater extraction wells, and infiltration gallery that were constructed for the Site groundwater remedy. This property, which is heavily wooded with long-leaf pine trees, is occasionally used by the current owner to harvest pine needles. The remnants of a foundation from a small building which is believed to have been part of a former peach orchard, is located on the leased parcel. With the exception of this structure, and the Site groundwater extraction and treatment system, the leased parcel is otherwise undeveloped.

Current land use of the area is rural residential and commercial in nature. In 2005, the Aberdeen Planning Department estimated that the Town of Aberdeen had approximately 4,665 residents. The estimated population in the Moore County area has grown approximately 7% between 2000 and 2005 and may continue this trend. Based on current levels of development of the area, it is not foreseen that there will be any major change in land-use at the Site in the future.

Public drinking water in the area of the Site is provided by The Town of Aberdeen Public Works Department. The Lower Black Creek aquifer serves as the primary source of drinking water for the Town of Aberdeen water supply system. The nearest active water supply well to the Site is Town Well No. 2, which is located approximately 3,000 feet northwest from the center of the Site, in an area where site-related pesticides have not been detected. The Town of Aberdeen has performed supplemental quarterly monitoring of Town Well No. 2 for alpha-, beta-, delta-, and

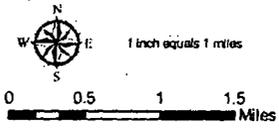
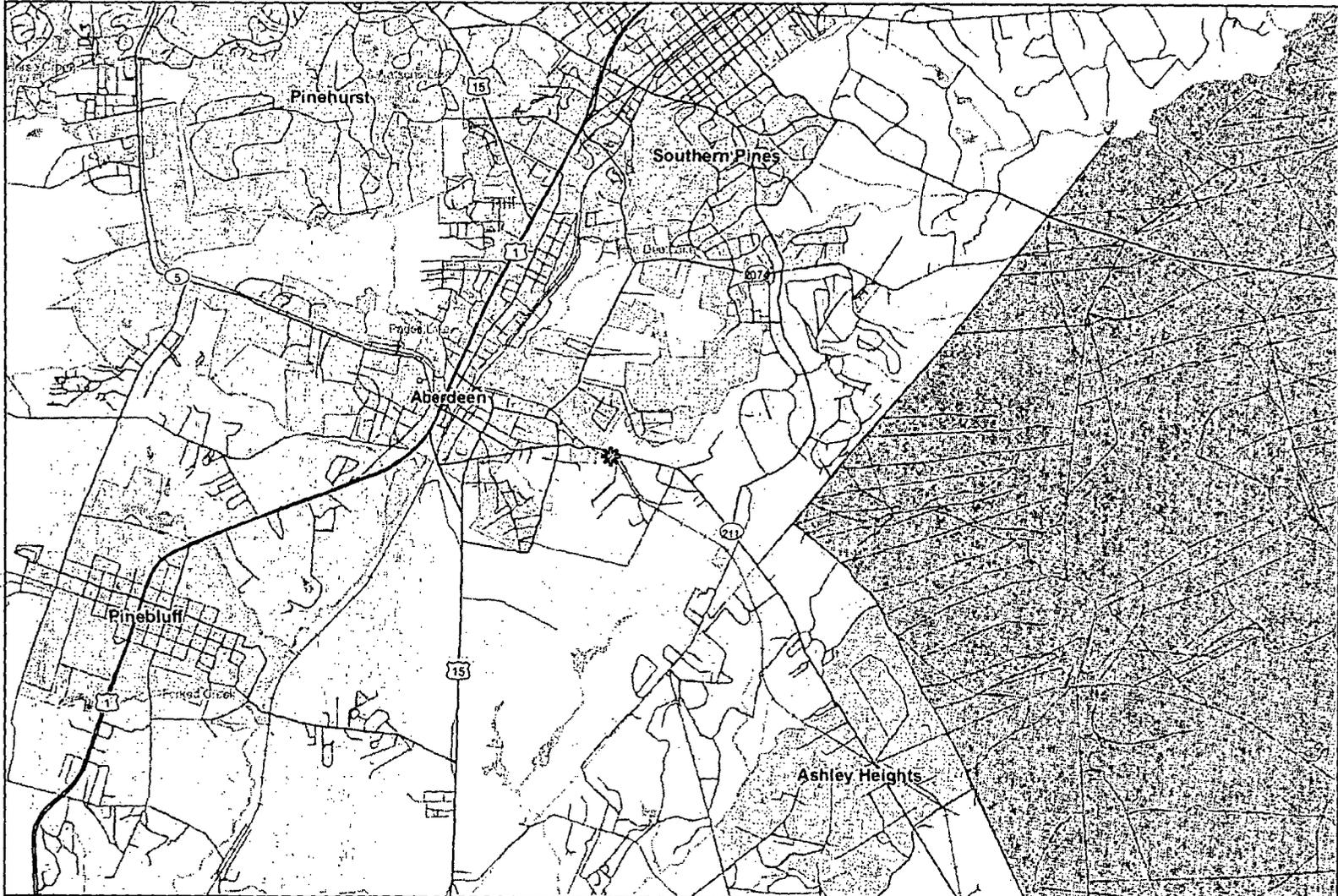


**Figure 3-1**  
 General Location  
 Geigy Chemical Corporation

- Geigy Chemical Corporation
- Wetlands
- State and National Parks
- City Areas
- Railroads
- Interstate
- US Hwy
- State and County Hwy
- Local Roads

Date: 06/12/2008  
 PM: MS  
 Drawn By: EP  
 Checked By: DO  
 Approved By: MS

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 Location: Map.mxd



**Figure 3-2**  
**Specific Site Location**  
 Geigy Chemical Corporation

Geigy Chemical Corporation	Interstates
City Areas	US Hwy's
Fort Bragg	State and County Hwy's
Lakes	Local Roads
	Railroad
	Rivers

Date: 06/12/2008  
 PM: MS  
 Drawn By: EP  
 Checked By: DO  
 Approved By: MS

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 \*D:\17\_Geigy\mapset\97\_98\scn1  
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gamma-BHC since 1996. Analytical results provided to the PSDs have shown that drinking water quality in Town Well No. 2 has consistently met applicable Federal drinking water standards during this time. Currently, there are no other active public or private drinking water supply wells in areas that are hydraulically downgradient of the Site.

### **3.3 HISTORY OF CONTAMINATION**

The Geigy Site was leased for the blending and retail sale of pesticides from 1947 until its closure in 1989. Agricultural fertilizers in bulk and bagged form were also distributed from the Site during its operational history. The pesticides dichlorodiphenyltrichloroethane (DDT), toxaphene, and benzene hexachloride (BHC) were blended for field use on-site by mixing with inert materials such as clay and repackaged for sale in the local agricultural market.

An EPA Site Investigation was conducted in March 1988 in support of the Hazard Ranking System (HRS) evaluation of the Site. Isomers of BHC were found in groundwater samples from five locations: three municipal wells and two private wells.

### **3.4 INITIAL RESPONSE**

Based on the findings of the 1988 Site Investigation, the Site was proposed to be included on the National Priorities List (NPL) in June 1988 and final designation was completed October 4, 1989. The NPL is a list of priority releases for long-term evaluation and remedial response, and was promulgated pursuant to section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended. The NPL list is found in the NCP (Appendix B of 40 CFR part 300).

During that time, special notice letters were sent to the six PRPs: Ciba-Geigy Corp, Olin Corp, Kaiser Aluminum & Chemical Corp, Lebanon Chemical Corp, Aberdeen and Rockfish Railroad, and Columbia Nitrogen Corporation. The special notice letters requested that these companies conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. An Administrative Order on Consent (AOC) was entered into by EPA and three of the PRPs (Ciba Geigy, currently Syngenta Crop Protection, Inc., Olin Corporation, and Kaiser Aluminum & Chemical Corporation) for performance of the RI/FS on December 16, 1988. These three PRPs conducted the RI/FS at the Site between 1988 and 1992.

There were three removal actions associated with the Site for soil remediation. The first two, conducted in 1989 and 1991, removed soils visibly contaminated and other debris from the Site. Approximately 3,300 tons of soil and debris were removed for disposal in these two actions. The 1989 removal action consisted of two phases. In the February 1989 phase, material removed was disposed of in the Subtitle C GSX landfill in Pinewood, South Carolina. The second phase in October 1989, resulted in soils being incinerated at the ThermalKem facility in Rock Hill, South Carolina or being transported as hazardous waste to the Laidlaw Environmental Services Landfill (formerly GSX Services) in Pinewood, South Carolina. During the 1991 removal, approximately 500 tons of soils were incinerated at the Rollins Facility in Deer Park, Texas. The remainder of the soil and debris, removed as required by the ROD (the third removal action) were disposed of at the Chemical Waste Management landfill in Carlyss, Louisiana.

### 3.4.1 Remedial Investigation

In 1990 and 1991, the PSDs conducted a RI at the Geigy Site to characterize site-related groundwater, soil and sediment contamination. Surface water samples were not collected because there are no nearby surface water bodies. In addition, two removals (in three phases) were conducted during the RI. The findings of the RI are summarized below.

#### 3.4.1.1 Groundwater

The groundwater investigation was conducted in two phases. In the first phase, ten groundwater monitoring wells were installed: six (MW-1S through MW-6S) in the shallow aquifer; three (MW-1D, MW-4D, and MW-6D) in the intermediate aquifer; and one in the deep aquifer (PZ-1). In addition, a former on-site water supply well was also included in the investigation. The sampling was conducted in November 1990. Analytical parameters included field parameters (pH, temperature, specific conductance), Target Compound List (TCL) volatiles, semivolatiles, and pesticides and Target Analyte List (TAL) metals.

Acetone was found in three wells, but was believed to be a laboratory contaminant because it was also found in blank samples. Xylene and bis(2-ethylhexyl)phthalate were each found in only one well at 4J  $\mu\text{g/l}$  (micrograms per liter) and 7J  $\mu\text{g/l}$ , respectively. The compound 1,2,4-trichlorobenzene was found in two wells, MW-5S and MW-6S, at 4J  $\mu\text{g/l}$  and 5J  $\mu\text{g/l}$  respectively. Trichloroethene (TCE) was found in two deep wells, MW-4D and MW-6D, at 200  $\mu\text{g/l}$  and 11  $\mu\text{g/l}$ , respectively, but was subsequently determined by EPA to not be site-related.

Pesticides were detected in all the shallow wells except MW-1S, which is a background well. Pesticides were not detected in the intermediate or deep wells. Gamma-BHC (lindane) was the most prevalent, ranging in concentration from 0.4  $\mu\text{g/l}$  to 30  $\mu\text{g/l}$ . Toxaphene was found in three wells in concentrations up to 10  $\mu\text{g/l}$ .

The secondary drinking water standard for iron (300  $\mu\text{g/l}$ ) was exceeded in six wells including both upgradient wells (MW-1S and MW-1D). Copper was detected in the water supply well at a concentration of 1,180  $\mu\text{g/l}$ , which is above the secondary drinking water standard of 1000  $\mu\text{g/l}$ . The Maximum Contaminant Level (MCL) for lead of 50  $\mu\text{g/l}$  was exceeded in the water supply well at 51B  $\mu\text{g/l}$ . None of the other wells contained lead above the MCL or the CERCLA cleanup level of 15  $\mu\text{g/l}$ .

Based on the results of the first phase of groundwater sampling, the investigation expanded laterally. Six additional monitoring wells were installed in areas downgradient of the existing monitoring well system in the shallow aquifer (MW-7S through MW-10S, MW-12S and MW-13S). In addition, three monitoring wells were installed in the intermediate aquifer (MW-11D, MW-14D, and MW-15D). Two of the intermediate wells, MW-14D and MW-15D, were installed to try to determine if the TCE found in wells MW-4D and MW-6D was coming from an upgradient source. In addition, two private wells were also sampled. Monitor wells MW-7S through MW-10S, MW-12S, MW-13S, MW-11D, MW-14D, and MW-15D were analyzed for TCL pesticides and volatile organics. Wells MW-1D, MW-4D, PZ-1, and two private wells,

Allred and Powder Metals Products, were analyzed for TCL volatiles only. The compounds 2-butanone, 1,1,1-trichloroethane, 4-methyl-2-pentanone, and toluene were found in only one well, the Powder Metals Products well, at concentrations below MCLs. TCE was found in the two private wells as well as monitoring wells MW-4D, MW-6D and PZ-1. The two upgradient deep wells, MW-14D and MW-15D, did not contain any TCE.

### 3.4.1.2 Soils

The soils investigation was conducted in four phases. Phase 1 provided a definition of potential Site-specific parameters for soils (TCL pesticides, copper, lead, zinc); Phase 2 defined the horizontal extent of contamination; Phase 3 delineated the vertical extent of contamination; and Phase 4 provided additional information to complete the data set.

Acetone was found in all Phase 1 soil samples, but was also found in the associated blank. Benzoic Acid was found in three samples ranging in concentrations from 360J  $\mu\text{g}/\text{kg}$  (micrograms per kilogram) to 3600J  $\mu\text{g}/\text{kg}$ . Most metal concentrations were within the range of the concentrations detected in the background sample (SS-04). Pesticides were detected in all Phase 1 soil samples. DDT was the most prevalent compound found. Toxaphene was found in three samples, with concentrations ranging up to 400,000  $\mu\text{g}/\text{kg}$ .

For the Phase 2 soils investigation, a forty-foot grid was established over the Site. The samples were analyzed for TCL pesticides, along with copper, lead, and zinc. Toxaphene and DDT were the most prevalent compounds found during this phase. In addition, two background soil samples, SS-121 and SS-122, were obtained north and east of the Site.

For Phase 3, the analytical results were reviewed to determine which sample locations contained significant concentrations of Site-specific parameters. The term significant was defined as a soil concentration level of 10 mg/kg (milligrams per kilogram) or greater total BHC, total DDT, or toxaphene. Sample grid locations exhibiting concentrations between 10 mg/kg and 100 mg/kg were re-sampled at two-foot and five-foot depth intervals. Sample grid locations with concentrations greater than 100 mg/kg were re-sampled at two, five, and ten-foot depth intervals.

Twenty Phase 3 soil samples at the two-foot depth contained pesticide constituents. Of these, only three samples contained a significant total pesticide concentration; SS-51-2 (50 mg/kg), SS-58-2 (32 mg/kg), and SS-100-2 (24 mg/kg). Pesticides were detected in 11 samples at a depth of five feet. Four samples contained pesticides at the ten-foot interval.

*For the Phase 4 investigation, sampling was conducted to further delineate the extent of contamination. During the Site investigation conducted in 1988, soil samples were collected near an old foundation located south of the Geigy property line. The previous use of the foundation and its original purpose are unknown. The results of the study indicated isomers of BHC and toxaphene at a depth of 22 feet below ground surface. Samples were collected near this foundation at the following depth intervals: 0-1 foot, 5-7 feet, 10-12 feet, 15-17 feet, and 20-22 feet. Analytical results revealed that the surface sample contained the highest concentration of total pesticides.*

### 3.4.1.3 Sediment

The sediment investigation for the drainage ditch that runs parallel to the railroad track was conducted in three phases. The first phase was performed to define the horizontal extent of contamination. In general, samples for the first phase were collected from the ground surface to a maximum depth of one-foot. The next phase included the collection of samples at one and two-foot depth intervals as well as samples downgradient of the first phase samples that contained significant concentrations of pesticides. The last phase consisted of samples collected at the two, five, and ten foot depth at locations exhibiting significant concentrations of pesticides in surface soils.

The same pesticides that were found in Site soil samples were also found in the sediment samples, namely, the BHC isomers, the DDT isomers and toxaphene.

### 3.5 BASIS FOR TAKING ACTION

Hazardous substances that were found in Site environmental media and identified in the ROD as Chemicals of Concern (COCs) include the following:

Soil	
CAS* #	Contaminant Name
309-00-2	ALDRIN
319-84-6	ALPHA-BHC
319-85-7	BETA-BHC
319-86-8	DELTA-BHC
50-29-3	DDT
57-74-9	ALPHA-CHLORDANE
57-74-9	GAMMA-CHLORDANE
58-89-9	GAMMA-BHC
60-57-1	DIELDRIN
72-54-8	DDD (DICHLORODIPHENYLDICHLOROETHANE)
72-55-9	DDE (DICHLORODIPHENYLDICHLOROETHYLENE)
8001-35-2	TOXAPHENE (POLYCHLORINATED CAMPHENES)
TBD-00000011	ENDRIN KETONE
* Chemical Abstract Service Registry Number	

<b>Groundwater</b>	
<b>CAS #</b>	<b>Contaminant Name</b>
309-00-2	ALDRIN
319-84-6	ALPHA-BHC
319-85-7	BETA-BHC
319-86-8	DELTA-BHC
58-89-9	GAMMA-BHC
60-57-1	DIELDRIN
72-20-8	ENDRIN
79-01-6	TRICHLOROETHYLENE *
8001-35-2	CAMPHECHLOR
* Trichloroethylene is no longer considered a Site-related Chemical of Concern as documented in a letter dated August 23, 1995 from Giezelle Bennett, U.S. EPA Region 4 to the Geigy Site PSDs, and subsequently noted in the Site Explanation of Significance Difference (ESD), January 23, 1998.	

The exposure assessment identified potential pathways and routes for contaminants of concern. Two overall exposure conditions were evaluated. The first was the current land use condition, which considers the Site as it currently exists. The second was the future land use condition, which evaluates potential risks that may be associated with potential changes in Site use assuming no remedial action occurs.

The exposure pathways that were evaluated under current land use conditions were:

- Incidental ingestion of chemicals in on-site and off-site surface soil/sediment by an older child trespasser (8-13 years),
- Dermal absorption of chemicals in on-site and off-site surface soil/sediment by an older child trespasser (8-13 years),
- Inhalation of volatilized surface soil/sediment chemicals by an older child trespasser (8-13 years),
- Inhalation of volatilized surface soil/sediment chemicals by a merchant north of the Site, Inhalation of volatilized surface soil sediment chemicals by a nearby child resident (1-6 years) and a nearby adult resident northeast of the Site,
- Inhalation of chemicals in wind blown dust particles by a nearby child resident (1-6 years) and a nearby adult resident northeast of the Site.
- Inhalation of chemicals in wind blown dust particles by a nearby merchant north of the Site.

The exposure pathways that were evaluated under future land use conditions were:

- Incidental ingestion of on-site surface soils/sediment by future on-site adult and child (1-6 years) residents and by a future on-site merchant,
- Dermal absorption of chemicals adsorbed to surface soils/sediments by future on-site adult and child (1-6 years) residents and by a future on-site merchant,

- Ingestion of groundwater by future on-site adult and child (1-6 years) residents and by a future on-site merchant,
- Inhalation of volatile organic chemicals while showering with groundwater by a future on-site adult and child (1-6 years) residents,
- Dermal absorption of chemicals while showering with groundwater by future on-site adult and child (1-6 years) residents, and
- Inhalation of volatilized surface soil/sediment chemicals by future on-site adult and child (1-6 years) residents, and by future on-site merchants.

For ingestion of soil, an exposure frequency of 170 days/year for residents and 120 days/year for merchants was assumed. (A merchant is assumed to work 5 days/week, 50 weeks/year (2 weeks subtracted for vacation), minus 9 days for federal holidays and is to spend half of that time outside. Values for adult and child residents are based on 5 days/week during the warmer months, April through October, and 1 day/week during November through March). The exposure duration used was 6 years for a child, 30 years for an adult, and 25 years for a merchant.

For ingestion of groundwater, an exposure frequency of 350 days/year for residents and 241 days/year for merchants was assumed. An ingestion rate of one liter per day was used for a child resident and an adult merchant. An ingestion rate of two liters per day was used for an adult resident.

#### **4.0 REMEDIAL ACTION**

In accordance with CERCLA and the NCP, the overriding goals for any remedial action are protection of human health and the environment and compliance with Applicable or Relevant and Appropriate Requirements (ARARs). A number of remedial alternatives were considered for the Site, and final selection made by EPA was based on an evaluation of each alternative against nine evaluation criteria that are specified in Section 300.430(f)(5)(i) of the NCP. The nine criteria include:

1. Overall Protectiveness of Human Health and the Environment
2. Compliance with ARARs
3. Long-Term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility or Volume of Contaminants through Treatment
5. Short-term Effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community Acceptance

## 4.1 REMEDY SELECTION

On August 27, 1992, EPA issued the ROD for the Geigy Chemical Superfund Site. Remedial Action Objectives (RAOs) were developed during the FS as a result of data collected during the RI to aid in the development and screening of remedial alternatives to be considered for the ROD. The RAOs for the Site were as follows:

- restore groundwater to its beneficial use as a drinking water source and
- remove or minimize the potential risk associated with the wastes through dermal, ingestion, and inhalation contact with Site contaminants by removing the contamination which poses a threat.

The following sections describe the selected components of the remedial action (RA) identified in the ROD.

### 4.1.1 Groundwater

The groundwater remedy focused on removing site-related contaminants in the groundwater through groundwater extraction and on-site treatment by carbon adsorption. The following activities were identified as being associated with this alternative:

- Contaminated groundwater above MCLs or the North Carolina Groundwater Standards, whichever are more protective or stringent, would be extracted from within the Surficial and Upper Black Creek aquifer plume via extraction well(s) and piped to an on-site, aboveground treatment facility.
- Treatment of extracted groundwater would consist of activated carbon adsorption to remove the COCs.
- Final discharge of the effluent would be to either an on-site infiltration gallery or via connection to the Publicly Owned Treatment Works (POTW).
- Continued analytical monitoring for COCs in the groundwater.
- Further characterization of the Upper Black Creek aquifer to determine the extent of pesticide contamination and to determine if the TCE found in two wells is site-related.

### 4.1.2 Soils

The target of the soil remedy was to permanently remove the contaminated soil from the Site through excavation and off-site disposal of the contaminated soils. The following activities were identified as being associated with this alternative:

- Demolition and the appropriate disposal of the former warehouse foundation;
- Excavation of the top foot of soils exceeding cleanup standards identified in the ROD;
- TCLP testing of the stockpile of contaminated soil to determine final disposition; Off-site incineration of contaminated soils that fail the TCLP test; Off-site disposal in an approved hazardous waste landfill of contaminated soils that pass the TCLP test;
- Confirmation sampling and analysis to ensure that remediation levels are attained; and

- Backfill of excavated areas with clean fill, re-grading of Site and re-vegetation with native grasses.

Tables 4-1 and 4-2 show the clean-up standards for soil and groundwater specified in the ROD. The soil clean-up standards were based on residential standards (page 9-5, Section IX of the ROD).

Contaminant	Clean-up Standard (mg/kg)
Aldrin	0.113
Alpha-BHC	0.28
Beta-BHC	1.15
Delta-BHC	NC
Gamma-BHC	1.5
Dieldrin	0.13
Endrin Ketone	NC
Toxaphene	2.0
DDD	7.6
DDE	5.5
DDT	4.75
Gamma-Chlordane	1.43
Alpha-Chlordane	1.4

Contents of this Table from Table 6-5, page 6-12 from the August 1992 ROD  
 mg/kg milligrams per kilogram or parts per million (ppm)  
 NC Not Calculated

Contaminant	Groundwater Clean-Up Standard (µg/l)	Corresponding Risk Level	Basis of Goal
Aldrin	0.05	$5.0 \times 10^{-6}$	CRQL
Alpha-BHC	0.05	$1.3 \times 10^{-6}$	CRQL
Beta-BHC	0.05	$4.0 \times 10^{-7}$	CRQL
Delta-BHC	0.05	ND	CRQL
Gamma-BHC	0.05	$3.0 \times 10^{-7}$	CRQL
Dieldrin	0.1	$8.3 \times 10^{-6}$	CRQL
Endrin Ketone	0.1	ND	CRQL
Toxaphene	1.0	$6.7 \times 10^{-6}$	NCGWQS

Contents of this Table from Table 7-5, page 7-15 from the August 1992 ROD  
 µg/l microgram per liter or part per billion (ppb)  
 CRQL Contract Required Quantitation Limit  
 NCGWQS North Carolina Groundwater Quality Standards  
 ND Not Determined, Toxicity data unavailable, risk levels could not be calculated.

The selected remedy within the ROD noted that if it is determined, on the basis of the preceding criteria and the system performance data, that certain portions of the aquifer cannot be restored to their beneficial use, all of the following measures involving long-term management may occur, for an indefinite period of time, as a modification of the existing system. The criteria are:

- a) engineering controls such as physical barriers, or long-term gradient control provided by low level pumping, as containment measures;
- b) chemical-specific ARARs will be waived for the cleanup of those portions of the aquifer based on the technical impracticability of achieving further containment reduction;
- c) institutional controls will be provided and maintained to restrict access to those portions of the aquifer which remain above health-based goals, since this aquifer is classified as a potential drinking water source;
- d) continued monitoring of specified wells; and
- e) periodic re-evaluation of remedial technologies for groundwater restoration.

The selected remedy within the ROD also noted that the decision to invoke any or all of these measures may be made during a periodic review of the RA, which will occur at intervals of at least every five years, in accordance with CERCLA 121(c). To ensure State and public involvement in this decision at this Site, any changes from the remediation goals identified in the ROD will be formalized in either an Explanation of Significant Difference (ESD) document or an Amendment to the ROD, thereby providing an opportunity for State and public comment.

The soil removal remediation was completed in early 1997. Site restoration was conducted in January 1997. A final inspection by EPA and the State of North Carolina Division of Superfund occurred on February 26, 1997.

Based on results of the pre-remedial design field investigation, showing the presence of pesticides in the Upper Black Creek aquifer, additional investigations of the downgradient areas were conducted. A *Downgradient Groundwater Investigation Work Plan* (Rust, 1995) was prepared and presented to the EPA and NCDENR to determine type, distribution and concentration of pesticides in the downgradient areas. Field investigations for the downgradient groundwater studies were conducted from March to October 1995. Results of the investigation were reported in the *Downgradient Investigation Summary Data Report* dated March 1996.

The PSDs and Agencies met in May of 1996 to discuss preparation of a RA plan for the downgradient area and agreed to develop a Remedial Action Work Plan (RAWP) that would evaluate the containment and attenuation of pesticide concentrations as a component of the RA for the downgradient area. The resulting RAWP, finalized in November 1997, has the following objectives:

- Reduce pesticide concentrations in downgradient groundwater to levels which are protective of human health and the environment
- Ensure that Site-related pesticide concentrations in downgradient surface water and stream sediments are protective of human health and aquatic receptors; and monitor

drinking water supplies in the downgradient area to verify they are not adversely impacted.

The RAWP defined the downgradient area as the portions of Upper and Lower Black Creek aquifers bounded by McFarland's Branch, Aberdeen Creek, Ray's Mill Creek, and Trough Branch. The surficial aquifer was excluded from the work plan. Data from the downgradient groundwater investigations revealed that the BHC isomers were the only target pesticides exceeding Federal or State drinking water standards or Site Performance Standards. As a result of the analyses, the goal of the downgradient RA is to reduce BHC isomer concentrations to levels below the North Carolina and Federal drinking water standards, to levels below the groundwater Performance Standards listed in **Table 4-2**. The downgradient groundwater Performance Standards are listed in **Table 4-3**.

<b>Table 4-3: Downgradient Groundwater Clean-up Standards</b>		
<b>Contaminant</b>	<b>Clean-up Standard (µg/l)</b>	<b>Basis of Standard</b>
Alpha-BHC	0.05	CRQL
Beta-BHC	0.05	CRQL
Delta-BHC	0.05	CRQL
Gamma-BHC	0.20	MCL/15A NCAC 2L
Contents of this Table from Table 3-1 from the November 1997 <i>Downgradient Groundwater Remedial Action Work Plan</i>		
CRQL Contract Required Quantitation Limit		
15A NCAC 2L North Carolina Groundwater Classifications and Standards		
µg/l microgram per liter or part per billion (ppb)		

The recommendations and proposed remedial Performance Standards for the downgradient groundwater in the RAWP were implemented by issuance of an ESD to the RA in January of 1998. The different performance standards for gamma-BHC (Lindane) between the Site remedy (0.05 µg/L; **Table 4-2**) and the downgradient remedy (0.2 µg/L; **Table 4-3**) reflect a change in the North Carolina Groundwater Standards (Title 15A North Carolina Administrative Code (NCAC) 2L.0202) between issuance of the ROD and ESD.

#### **4.1.3 January 23, 1998 Explanation of Significant Difference**

The 1992 ROD required additional sampling in the second uppermost aquifer to determine the extent of the pesticide contamination and to determine if TCE was a site-related contaminant. The work that accomplished these two goals was captured in the 1997 report entitled *Downgradient Groundwater Remedial Action Work Plan*. This document delineated the extent of pesticide contamination in the groundwater (RAWP) of the source area and determined that TCE is not a site-related contaminant. Contaminated groundwater was documented to be discharging into the surface streams downgradient of the Site. Consequently, a screening-level risk assessments were conducted to assess potential human health and ecological risks associated with the detected concentrations of pesticides in the surface waters. The results of this effort can

be found in Appendix C – Surface Water and Sediment Risk Assessment of the RAWP. The conclusions of the human health risk effort are as follows: The exposure routes examined in the risk assessment were: (1) incidental ingestion of sediment; (2) dermal absorption of chemicals from sediment; (3) dermal absorption of chemicals from water; and (4) incidental ingestion of water. The predicted lifetime excess cancer risks were in the range of  $4 \times 10^{-11}$  to  $2 \times 10^{-8}$ , and the predicted non-cancer hazard indices were in the range of  $4 \times 10^{-7}$  to  $2 \times 10^{-5}$ . Cumulative risks across all pathways were  $2 \times 10^{-8}$  for excess lifetime cancer risks and between  $1 \times 10^{-4}$  and  $2 \times 10^{-6}$  for non-cancer hazard indices. The conclusions for the ecological risk assessment are as follows: Potential risks were evaluated for aquatic life inhabiting McFarland's Branch and Ray's Mill Creek, and bird species feeding in these waters. The predicted hazard indices for aquatic life were in the range of  $2 \times 10^{-3}$  to  $1 \times 10^{-1}$  for surface water and sediment exposures. The predicted hazard indices for birds feeding in these waters were in the range of  $2 \times 10^{-5}$  to  $1 \times 10^{-3}$ . The predicted aquatic life and avian risks are below EPA's target screening risk level of 1. (The ecological risk assessment was performed in accordance with EPA's guidance for conducting ecological risk assessments, as supplemented by Region IV ecological risk assessment guidance.)

The RAWP also documented that periodic monitoring of the downgradient portion of the plume along with periodic monitoring of the surface water bodies would address the downgradient groundwater contamination. This approach is supported by the following components:

- There are no receptors of untreated groundwater in the downgradient area;
- An April 1997 letter from the Town of Aberdeen informs EPA that the Town would not install any municipal water supply wells in this downgradient area;
- Groundwater discharge to surface water limits the further migration of the plume;
- Pesticide concentrations in surface water do not currently pose a risk to human health or the environment; and
- Groundwater modeling has shown that the concentrations of pesticides in this downgradient area will decrease in a timeframe comparable to a pump-and-treat system.

Therefore, the 1998 ESD acknowledges that TCE is not a site-related contaminant and requires periodic sampling of the downgradient groundwater and surface water. This is currently being conducted on an annual basis.

#### 4.2 REMEDY IMPLEMENTATION

Following the preparation and finalization of a Remedial Investigation/Feasibility Study, a ROD was signed August 27, 1992. EPA and the PSDs entered into a Consent Decree that covered the Remedial Design (RD) and RA phases in July 1993. The PSDs at that time consisted of Olin Corporation, Ciba-Geigy Corporation (now Syngenta Crop Protection), and Kaiser Aluminum & Chemical Corporation. The RD was started in May 1993 and was completed in February 1996. The RA implemented by the ROD included demolition of the former warehouse foundation; excavation of the top foot of on-site soils/sediments contaminated above performance standards; off-site disposal of excavated soils as appropriate; extraction of groundwater from the surficial and Upper Black Creek aquifers; treatment of extracted groundwater via carbon adsorption; Site

restoration; and further sampling and analysis of the Upper Black Creek aquifer to determine extent of pesticide contamination and determine if TCE found in two on-site wells was site-related.

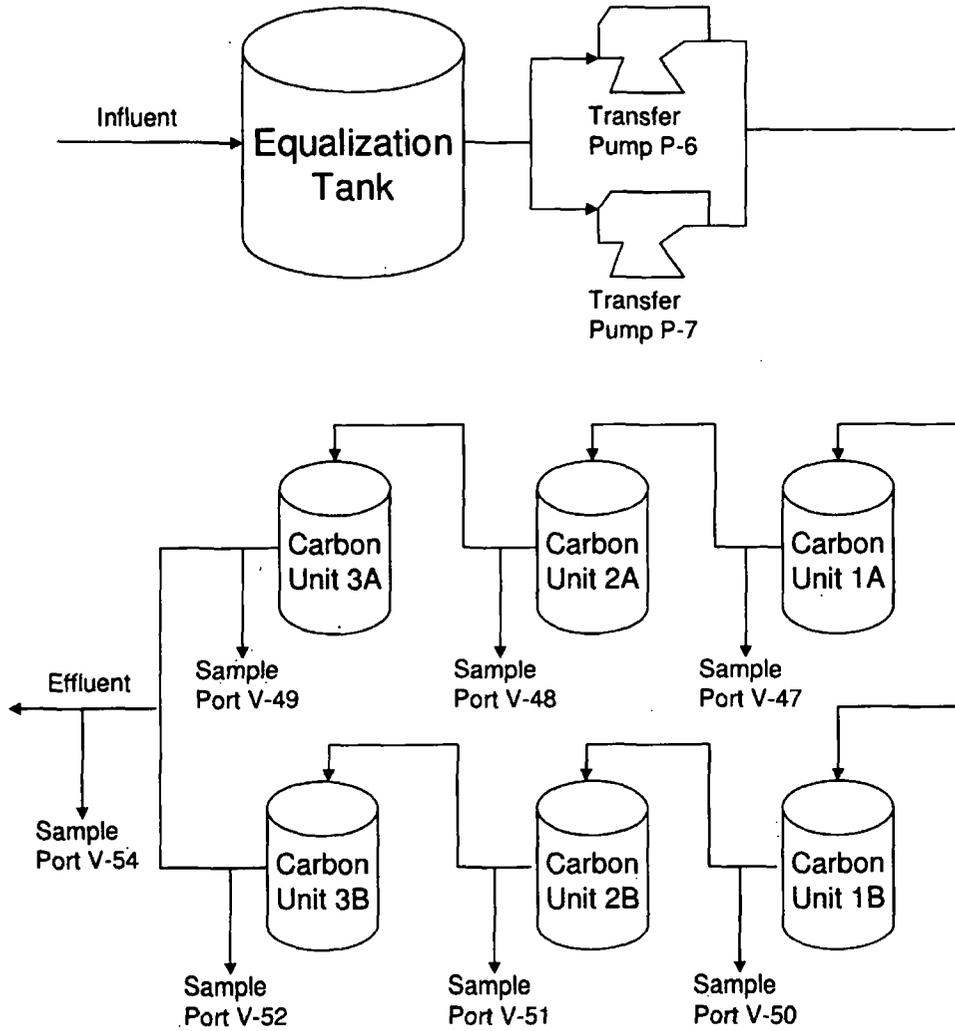
The RA was conducted from September 1996 to February 1997. The RA included removal of concrete foundations and other debris totaling approximately 2,460 tons to a Subtitle D landfill in Kernersville, North Carolina; and disposal of 4,475 tons of contaminated soils to a Subtitle C landfill in Pinewood, South Carolina; construction and installation of extraction wells and groundwater treatment facilities with an infiltration gallery for discharge of treated groundwater. Building demolition, soil removal, and construction of the Site groundwater extraction and treatment system were performed by OHM Corporation, under the oversight of the Greenville, South Carolina office of RUST Environment & Infrastructure, Inc. (now Earth Tech/AECOM). Details regarding the lateral and vertical extent of soils excavated for the remedy, including analytical testing conducted to verify compliance with numeric cleanup goals were provided in the Final Remedial Action Report for Soils, which was submitted to US EPA Region IV on June 6, 1997. Excavated areas were not backfilled until confirmation sampling verified that the remaining soil met Site specific clean-up goals. The groundwater treatment system began operation in January 1997 and has successfully treated approximately 82 million gallons of extracted groundwater from the surficial and Upper Black Creek aquifers.

Although not required by the 1992 ROD, the PSDs abandoned the Town of Aberdeen's Municipal Supply Well (MSW) #1 in July 1995. This well was screened in the Lower Black Creek aquifer and the Town of Aberdeen had taken this well offline due to the presence of pesticides in groundwater samples collected from this well. Because there is some risk for Site COCs impacting MSW #2, which is also screened in the Lower Black Creek aquifer, the PSDs installed monitoring well MW-36L upgradient of MSW #2. MW-36L is also screened in the Lower Black Creek aquifer. Based on the flow rate of the groundwater in the aquifer in this area, MW-36L located approximately one year travel time upgradient of MSW #2 (**Figure 4-2**). MW-36L is considered a sentinel well. To date, no contaminants have been detected in MW-36L.

#### 4.3 SYSTEM OPERATIONS/OPERATION & MAINTENANCE

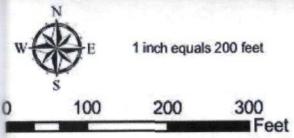
After completion of the RA in 1996, the Site was revegetated with native species and planted long-leaf pines. Since establishment of vegetation, the Site has not experienced erosion or other problems. Currently, the Site is mowed twice a year to maintain a neat appearance along the right-of-way for NC 211.

As required in the ROD and ESD, the PSDs have been operating a pump and treat system for remediation of the surficial and Upper Black Creek Aquifers since January of 1997 and monitoring the downgradient area since April of 1998. **Figure 4-1** shows a conceptual flow model of the pump and treat system. The PSDs have been responsible for the conduct of all O&M tasks and monitoring requirements/operating conditions listed in the Site Groundwater Remediation Permit (**Appendix D**), including monthly inspections of the treatment system and extraction wells. The Site Groundwater Remediation Permit lists COCs to be monitored, monitoring locations and frequencies. **Appendix C** provides copies of the monthly treatment system inspection reports filled out during the remedy review period.



**Figure 4-1**  
**Treatment System**  
**Process Layout**  
Geigy Chemical Corporation Site





**Figure 4-3**  
 On-site Monitoring Well  
 and Sampling Locations  
 Geigy Chemical Corporation

- ▲ Extraction Wells
- ◆ Lower Black Creek Aquifer Monitoring Wells
- Upper Black Creek Aquifer Monitoring Wells
- Shallow Wells
- Municipal Wells

Date: 06/12/2008  
 PM: MS  
 Drawn By: EP  
 Checked By: DO  
 Approved By: MS

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 SiteArea\_MonitoringLocations.mxd

Initial monitoring requirements for the downgradient area called for quarterly sampling for the first three years followed by semi-annual sampling for an additional two years. Following submission of the Downgradient Remedy Summary Report to the State and EPA in 2001, it was agreed by all parties that annual monitoring could be undertaken. The most recent round of monitoring well sampling occurred in October of 2007. Monitoring well (MW) and surface water sampling locations are shown in **Figures 4-2** and **4-3**. Wells that are currently sampled on an annual basis are as follows:

- Surficial Aquifer: MW-4S, MW-5S, MW-6S, MW-10S;
- Upper Black Creek Aquifer: MW-11D, MW-18D, MW-30D, MW-19D, MW-20D, MW-22D, MW-23D, MW-24D, MW-25D, MW-26D, MW-35D\*, MW-29D, MW-34D; and
- Lower Black Creek Aquifer: MW-22L, MW-25L, MW-27L, MW-37L, MW-40L, PZ-2, PZ-3, MW-28L, MW-31L, MW-38L, MW-39L, MW-32L, PZ-5, MW-36L.

\* – Sampling of MW-35D was discontinued in October 2004 at the request of the property owner, Golf Capital Broadcasting, due to concerns that sampling personnel might inadvertently damage AM radio antenna wires buried just beneath ground surface on the property.

The 1992 ROD forecasted an estimated annual present worth O&M cost of \$50,000 per year of operation. As currently implemented the treatment and monitoring program costs approximately \$65,000 - \$75,000 annually to operate. Annual operation costs have increased as a result of inflation, the need for equipment replacement as the system ages, and the increased consumption of granular activated carbon used to treat extracted groundwater due to the presence of TCE from an upgradient source.

The system has treated approximately 82 million gallons of groundwater, operating at a pumping rate of 11 to 18 gallons per minute. The infiltration gallery contains 3 laterals; each being 175 feet long. The distribution of flow within the gallery is determined by a preset timer that activates solenoid valves at the gallery header. The timer is set to direct flow to two of the laterals at a given time. It alternates flow among the three laterals on an 8-hour cycle. As operated, each lateral will receive an average of half of the effluent from for 16 hours and no flow for the following 8 hours. The flow cycle is as follows:

- First 8 hours: Flow to laterals 1 and 2;
- Next 8 hours: Flow to laterals 2 and 3; and
- Next 8 hours: Flow to laterals 3 and 1.

The change-out/longevity period for the carbon adsorption canisters was initially one year, but has shortened to a six month time period. It is suspected that this change is due to increasing levels of TCE coming from an unknown source upgradient of the Site. A table in **Table 7-1 (Appendix F)** calculated approximately 3.9 pounds of pesticides have been removed from the aquifers by the groundwater pump and treat system.

## 5.0 PROGRESS SINCE LAST REVIEW

### 5.1 PROTECTIVENESS STATEMENTS FROM LAST REVIEW

The following is an excerpt of the Protectiveness Statements section of the first Five-Year Remedy Review Report:

“The remedy at the Geigy Chemical Corp. (Aberdeen Plant) Site is expected to be or is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.”

### 5.2 STATUSES OF RECOMMENDATIONS AND FOLLOW-UP ACTIONS FROM LAST REVIEW

Table 5-1 summarizes the recommendations and follow-up actions that were identified in the First Five-Year Review and their current status.

<b>Table 5-1: Status of Previous Recommendations and Follow-up Actions</b>					
<b>Recommendations/ Follow-up Actions</b>	<b>Responsible Party</b>	<b>Oversight Agency</b>	<b>Milestone Date</b>	<b>Follow-up Actions Affects Protectiveness (Y/N)</b>	<b>Status</b>
Fencing and signage should not be required as the site soils have been remediated. EPA should issue an ESD to eliminate requirement for fencing and signage.	EPA	EPA/NCDENR	Before next five year review as required	N	Open
Update Groundwater Remediation Permit to reflect actual number of recovery wells when renewed.	PSDs	NCDENR	Upon renewal of current permit – June 30, 2004	N	Completed
Continued monitoring of affect(s) of off-site TCE contaminant plume on the site remedy	PSDs, EPA and NCDENR	EPA/NCDENR	Before next five year review as required	N	Ongoing

### 5.3 RESULTS OF IMPLEMENTED ACTIONS

The Region still needs to complete the administrative requirement of issuing an ESD to remove the 1992 ROD requirement of installing a fence around the foot-print of the source area along with the appropriate signage on the fence.

The PSDs updated NCDENR Groundwater Remediation Permit No. WQ0009949, which was renewed on December 10, 2004, to accurately reflect the number of groundwater extraction wells in use at the Site. The permit expires November 30, 2009. A copy of the permit is included in **Appendix D** of this report.

The PSDs continued to monitor levels of TCE in the groundwater treatment system on a quarterly basis during the remedy review period. The monitoring results indicate that concentrations of TCE from an upgradient source continue to be present in groundwater at the Site at levels above North Carolina groundwater quality standards.

## **6.0 FIVE-YEAR REVIEW PROCESS**

### **6.1 ADMINISTRATIVE COMPONENTS**

The Geigy Chemical Site Second Five-Year Review Team was led by Jon Bornholm, EPA Remedial Project Manager for the Site. The following individuals were team members for the Second Five-Year Review:

- Beth Hartzell, NCDENR, Superfund Section
- Doug Rumford, NCDENR, Superfund Section
- Garland Hilliard, Olin Corporation
- James Cashwell, Olin Corporation
- Harold Moats, Syngenta Crop Protection
- Michael Sheehan, North Wind, Inc.

Technical expertise for the review was provided by Mr. Ray Horn of Olin Corporation and Mr. Harold Moats of Syngenta Crop Protection and Michael Sheenan, the PSDs' consultant with North Wind, Inc. State concerns for the Site were identified and discussed with Beth Hartzell and Doug Rumford, NCDENR, Superfund Section who also provided peer review of the draft Five-Year Review Report.

Components of the Five-Year Review include:

- Document review;
- Data review and evaluation;
- Community notification;
- Other Community Involvement Activities;
- Site inspection;
- Site interviews; and
- Five-Year Review Report development and review.

The review team established the following schedule for execution of the second Five-Year Review. This schedule also identifies when each Action Item was completed.

Action Item	Scheduled Date	Actual Date
Site Inspection	April 2, 2008	April 2, 2008
Submittal of Draft Second Five-Year Draft Report	June 10, 2008	July 10, 2008
EPA Comments on Draft Report	July 8, 2008	July 30, 2008 (minus input from NCDENR)
Submittal of Revised Five-Year Report	July 29, 2008	September 15, 2008

## 6.2 COMMUNITY NOTIFICATION AND INVOLVEMENT

Activities to involve the community in the second Five-Year Review process were initiated with EPA posting a notice in the March 5, 2008 edition of The Pilot, the local newspaper (refer to **Appendix G**). The notice informed the public of the following:

- the Agency was initiating a second Five-Year Review for the Geigy Superfund Site which was to be concluded by September 30, 2008;
- within thirty (30) calendar days of finalizing the Second Five-Year Review Report, a second notice will be published in The Pilot announcing that the review is complete; and
- the results of the review and the report will be available to the public at the information repository which is located at the Page Memorial Library, 100 South Poplar Street, Aberdeen, NC 28315 and that the report will also be placed in the administrative file in the EPA Region 4 office and on the U.S. EPA website (<http://www.epa.gov/superfund/index.htm>).

Members of the PSDs were notified of the initiation of the five-year review in a letter dated November 16, 2007 from Mr. Jon Bornholm, US EPA to Mr. Ray Horn of Olin Corporation and Mr. Harold Moats of Syngenta Crop Protection, who were invited at that time to assist the Agency with the preparation of this report. The PSDs conveyed their willingness to assist the Agency with the preparation of this report in a letter to US EPA dated November 26, 2007.

Representatives for US EPA Region 4, NCDENR and the PSDs held a conference call on December 13, 2007 to kick-off the planning process for the remedy review.

## 6.3 DOCUMENT REVIEW

The Second Five-Year Remedy Review included an examination of relevant Site documents and project files. Documents that were reviewed included:

- Site Record of Decision
- Site Explanation of Significant Difference
- Final Design Report
- Site Groundwater Remediation O&M Manual
- Site Quarterly Progress Reports

- Site Groundwater Remediation Annual Operating Reports
- Downgradient Area Annual Monitoring Reports
- Town of Aberdeen Municipal Water Supply Well No. 2 Quarterly Monitoring Results
- First Five-Year Remedy Review Report
- Geigy Site Groundwater Remediation Permit WQ0009949
- Final Remedial Action Report for Soils (1997)
- Final Downgradient Groundwater Remedial Action Work Plan, Appendix C - Surface Water and Sediment Risk Assessment (September 1997, RUST Environment & Infrastructure)
- PSDs project files and records of communications
- pertinent guidances.

#### 6.4 DATA REVIEW AND EVALUATION

Data sources consulted for this report included the following:

- Quarterly groundwater treatment system monitoring results (**Appendix A**).
- Monthly treatment system inspection records, including monthly flow measurement readings for the Site groundwater extraction wells and treatment system (**Appendix C**).
- Results of annual groundwater samples required by the site Groundwater Remediation Permit (**Appendix A**).
- Results of annual groundwater and surface water samples collected for the site downgradient area groundwater remedy (**Appendix A**).
- Annual water-level measurements obtained the Site downgradient area groundwater remedy and Groundwater Remediation Permit monitoring (**Appendix A**).
- Moore County tax records of properties containing monitoring locations for the Site downgradient area groundwater remedy (**Table 6.1**, found in **Appendix F**).

Additional information concerning data that were evaluated for this remedy review is provided below. Findings of the data evaluation are presented in Section 7.0 of this report.

##### 6.4.1 Groundwater Monitoring

The PSDs currently monitor Site groundwater quality and groundwater potentiometric surface levels on an annual basis (every October) to address monitoring requirements specified in the Site Groundwater Remediation Permit (NCDENR Groundwater Remediation Permit No. WQ0009949) and to address monitoring requirements for the monitored natural attenuation (MNA) component of the remedy. The MNA component of the remedy was defined through the ESD that was signed by EPA in January 1998.

Current groundwater monitoring locations are shown in **Figures 4-2** and **4-3** and identified in Section 4.3 above. Property ownership information for the groundwater monitoring locations in the downgradient area is shown in **Table 6-1 (Appendix F)**. Groundwater samples are tested for the presence of US EPA Target Compound List Pesticides. Monitoring wells MW-16S, MW-17S and MW-18S, which are located by the infiltration gallery serving the Site groundwater

extraction and treatment system, are also tested for TCE in accordance with the requirements listed in the Groundwater Remediation Permit.

Groundwater monitoring analytical results obtained during the review period (October 2003 to present) is summarized in **Appendix A**. Concentration trend graphs illustrating the changes in BHC isomer levels observed at the groundwater monitoring locations are provided in **Appendix B**. Review of the concentration trend graphs are described in the following sections for the surficial, Upper Black Creek, and Lower Black Creek aquifers.

#### **6.4.1.1 Surficial Aquifer**

Groundwater quality data for surficial aquifer monitoring wells MW-4S, MW-5S, MW-6S and MW-10S indicate overall declines in the concentrations of alpha-, delta- and gamma-BHC during the time period extending from 1991 (completion of the Site RI) to present. Concentration declines for these constituents were greatest in well MW-6S, located near the former source area. In general, concentrations of these constituents in the surficial aquifer exhibited an overall incremental reduction following the removal of contaminated soils from the former source area in 1996, although some fluctuations in concentration levels appeared to have occurred following the removal action.

Concentrations of beta-BHC in the surficial aquifer also exhibit an overall reduction from 1991 to present, although several wells (MW-4S, MW-5S and MW-10S) showed pronounced fluctuations in beta-BHC levels from one annual monitoring event to the next.

#### **6.4.1.2 Upper Black Creek Aquifer**

Groundwater quality data for Upper Black Creek aquifer monitoring wells MW-11D, MW-18D, MW-19D, MW-20D, MW-22D, MW-23D, MW-24D, MW-25D, MW-26D, MW-30D, MW-34D and MW-35D indicate overall declines in the concentrations of alpha-, delta- and gamma-BHC during the time period extending from 1995 (start of downgradient area monitoring) to present. In particular, concentration declines for these constituents were greatest in wells MW-11D, MW-18D, MW-20D, MW-22D, and MW-30D. Significant concentration declines were observed in wells MW-20D and MW-22D, located downgradient of the Site groundwater extraction system.

Concentration trends for beta-BHC observed in wells MW-11D, MW-18D and MW-30D have not closely correlated with trends observed for alpha-, delta- and gamma-BHC in these wells. Each of these wells lie within the capture zone formed by the Site groundwater extraction system; therefore, the groundwater at wells MW-11D, MW-18D and MW-30D is expected to be drawn into the Site groundwater treatment system over time.

#### **6.4.1.3 Lower Black Creek Aquifer**

Groundwater quality data for Lower Black Creek aquifer monitoring wells MW-22L, MW-25L, and MW-27L, all located within or near the area where the Upper and Lower Black Creek aquifers are in hydraulic communication, indicate declines in the concentrations of alpha-, beta-, delta- and gamma-BHC during the time period extending from 1995 (start of downgradient area

monitoring) to present. Wells MW-28L, MW-31L, MW-32L, MW-38L, MW-39L, MW-40L, PZ-2, and PZ-3, all located in distal portions of the downgradient area, indicate steady state conditions for alpha-, beta-, delta- and gamma-BHC concentrations during this time period. BHC isomer concentrations observed in wells MW-37L and PZ-5 have increased slightly since they were initially monitored, but have exhibited little change during the remedy review period.

#### 6.4.2 Surface Water Monitoring

The PSDs currently test surface water quality in portions of McFarland's Branch and Aberdeen Creek on an annual basis (every October) for the downgradient area remedy. Sample locations are shown in **Figure 4-2**. The surface water samples are tested for the presence of alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, heptachlor, and heptachlor epoxide.

Surface water monitoring analytical results obtained during the review period (October 2003 to present) are summarized in **Appendix A**. Concentration trend graphs illustrating the changes in BHC isomer levels observed at the surface water monitoring locations are provided in **Appendix B**.

Pesticide concentrations measured in surface water samples collected from Aberdeen Creek (SW-4, SW-5, SW-6, SW-7, SW-8, SW-11-2) have historically been measured and reported by the analytical laboratory as estimated concentrations (i.e., pesticide compound levels were detected at trace levels, but at concentration levels too low to be accurately quantified). As such, there has been very little variability in the data and no significant observed concentration trends.

#### 6.4.3 Soils

As noted in the initial Five-Year Remedy Review Report, soil contamination data have not been collected since the soil phase of the RA was completed. RA construction work included the removal of the remaining concrete foundations and hauling 2,460 tons of debris to a Subtitle D landfill in Kernersville, NC, as well as hauling 4,475 tons of contaminated soils to a Subtitle C landfill in Pinewood, SC in accordance with the approved Remedial Action Plan.

Performance Standards for soils were met as a result of the RA. Findings of the final soils testing were incorporated into the Final Remedial Action Report for Soils (1997) which documents that the soil clean-up goals were attained in the excavations.

### 6.5 SITE INSPECTION

A Site inspection of the Geigy Site was performed by the team members on April 2, 2008. Agency and PRP representatives attending the inspection included:

- Jon Bornholm, Remedial Project Manager, U.S. Environmental Protection Agency, Region 4.
- Elizabeth Hartzell, Federal Remediation Branch, Superfund Section, NCDENR.
- Doug Rumford, Federal Remediation Branch, Superfund Section, NCDENR.

- James Cashwell, Olin Corporation.
- Harold Moats, Syngenta Crop Protection.
- Michael Sheehan, North Wind, Inc.
- Dan Osbourne, North Wind, Inc.

The purpose of the Site inspection was to visually evaluate the general condition of the groundwater treatment building and treatment equipment, extraction wells, monitoring wells, piezometers, infiltration gallery laterals, vegetative cover and clean soil cover, and to perform a reconnaissance of downgradient area to assess land use changes in areas where site-related pesticides are present in groundwater.

Mr. Sheehan gave a brief historical overview of site activities, and provided access to the treatment building so the team could inspect the general condition of the treatment system. The team subsequently walked the site grounds to inspect the former source area and groundwater extraction wells, and then rode through portions of the residential and business districts in the downgradient area.

The inspection found that the treatment system was in good condition, and that no significant modifications to the treatment equipment or extraction wells have been made since the system was placed into operation.

The inspection found that the Site area had not been redeveloped or substantially altered since the RA was completed in 1996. The area lying south of Hwy. 211 by the Aberdeen and Rockfish rail line was found to be vegetated with the grasses and long-leaf pine trees that were planted to stabilize the clean backfill soils that were placed as part of the remedy. No sign of erosion was observed. The surface soil excavation area located on the north side of Hwy 211 and adjacent to the Aberdeen and Rockfish rail line was found to be vegetated with a dense cover of long-leaf pine trees, which planted as part of the remedy to stabilize clean backfill soils. With the exception of the service roads leading to the Site extraction wells and the infiltration gallery laterals, the area south of the Aberdeen and Rockfish rail line remains heavily forested. The infiltration gallery laterals were found to be vegetated with grasses and in good condition. Site photographs are presented in **Appendix E**.

## 6.6 SITE INTERVIEWS

Four (4) telephone interviews were conducted as part of this Five Year Review process. Parties impacted by the Site, including regulatory agencies and nearby residents involved in and aware of the Site, were contacted for interviews by EPA's Community Involvement Coordinator, Ms. Linda Stark. The purpose of the interviews was to document Site status and any issues or successes with the current progress with the remedy. People interviewed included representatives from the City of Aberdeen, the North Carolina Department of Environment and Natural Resources, and nearby residents. The interviewees were not aware of any major issues with the Site. Overall, they were pleased with how the Site has been operating. There is a concern for the TCE on the site. Even with the concern for TCE, they do feel comfortable that there are no drinking water wells on the Site.

## **7.0 TECHNICAL ASSESSMENT**

A primary purpose of the Five-Year Review is to determine the effectiveness and protectiveness of the remedy. Per the *Comprehensive Five-Year Review Guidance* (EPA, June 2001), the review should address the following three questions as part of this determination:

- Question A: Is the remedy functioning as intended by the Decision Documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used the time of remedy selection still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

An assessment of the remedy's intended function (Question A) is presented in Section 7.1. An assessment of changes in exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection (Question B) is presented in Section 7.2. An assessment of other information that could call into question the protectiveness of the remedy (Question C) is presented in Section 7.3. Section 7.4 presents a summary of the Technical Assessment.

### **7.1 ASSESSMENT OF INTENDED REMEDY FUNCTION**

Factors evaluated by this Five-Year Review to assess the intended function of the remedy included (1) overall RA performance and monitoring results, (2) systems operations and operations & maintenance, (3) opportunities for optimization, (4) early indicators of remedy performance, and (5) institutional controls and other measures.

#### **7.1.1 Remedial Action Performance and Monitoring Results**

RA performance and monitoring results for soils, the groundwater extraction and treatment system, and the MNA remedy for the downgradient area are discussed below.

##### **7.1.1.1 Soils**

Construction activities for the soils remedy were completed in 1997. Performance Standards for soils were met at that time as a result of the RA. Findings of the final soils testing were documented in the Final Remedial Action Report for Soils (1997). Monthly inspections performed during the review period as well as the April 2, 2008 Site inspection revealed that the clean soil cover used to backfill the soil excavations remain in place and there are no issues with the vegetative cover.

##### **7.1.1.2 Groundwater Extraction and Treatment System**

Upper Black Creek aquifer monitoring wells MW-11D, MW-18D, and MW-30D, which lie within the extraction system capture zone, and Surficial aquifer monitoring wells MW-4S, MW-

5S, MW-6S, and MW-10S, which lie near the former source area, are sampled annually to track the effectiveness of the remedy. BHC isomer concentration trend graphs for these wells presented in **Appendix B** show that levels of alpha-, delta-, and gamma-BHC in groundwater have decreased significantly since the system was placed into operation, although they remain above the performance standards set by the ROD. Levels of beta-BHC in these indicator wells have also generally decreased over this same time period. This data appears to indicate that the advective flow of BHC from the former source area towards the extractions wells located immediately downgradient of MW-18D and MW-30D, where the BHC will eventually be captured, is occurring. Overall, the rate of decline in BHC isomer concentrations is diminishing with time, which is consistent with performance expectations for a groundwater pump and treat system.

### 7.1.1.3 Downgradient Area Monitored Natural Attenuation

Upper Black Creek aquifer monitoring wells that have been used to measure the natural attenuation of pesticides in the area downgradient of the groundwater extraction and treatment system include MW-19D, MW-20D, MW-22D, MW-23D, MW-24D, MW-25D, MW-26D, MW-34D and MW-35D. BHC isomer concentration trend graphs for these wells are presented in **Appendix B**.

Lower Black Creek aquifer monitoring wells that have been used to measure the natural attenuation of pesticides in the downgradient area include MW-22L, MW-25L, MW-27L, MW-28L, MW-31L, MW-32L, MW-36L, MW-37L, MW-38L, MW-39L, MW-40L, PZ-2, PZ-3 and PZ-5. BHC isomer concentration trend graphs for these wells are presented in **Appendix B**.

Overall, the trend graphs show declining pesticide concentrations in the downgradient portions of the Upper and Lower Black Creek aquifers. Decreases in pesticide concentrations have been greatest at wells MW-20D and MW-22D, which lie immediately downgradient of the groundwater extraction system capture zone. Significant decreases have also been observed at well MW-27L, which exhibited the highest levels of pesticides when the downgradient area remedy was developed.

Some of the monitoring wells (MW-37L, MW-40L and PZ-5) located in the distal (westerly) portion of the downgradient area have shown nominal increases in BHC isomer concentrations. These increases reflect the advection of the pesticides with groundwater flow but do not pose risk to surface water at the discharge boundaries based on the database created from the results of the annual surface water samples collected from McFarland's Branch and Aberdeen Creek (monitoring results presented in **Appendix A**). Monitoring of these streams will continue to insure any change in concentrations will be identified.

BHC isomer concentration trend graphs for surface water monitoring locations in McFarland's Branch and Aberdeen Creek are shown in **Appendix B**. Considering the scale used to represent the very low concentrations detected in these streams, no appreciable changes in BHC isomer levels have been observed in surface water since the downgradient remedy was implemented.

### **7.1.2 System Operations/Operation & Maintenance**

**Table 7-1 (Appendix F)** presents a summary of flow measurements recorded for each of the seven (7) pumping wells that comprise the extraction system, and flow measurements recorded by the treatment system. Since startup, the extraction and treatment system has processed approximately 82,000,000 gallons of groundwater.

Compared to the first five years of operation, the average flow rate for the extraction and treatment system dropped. The decrease in the rate of groundwater recovery is believed to be due in part to 1) declining water-levels at the Site associated with a severe drought being experienced by the southeastern US and 2) an increase in the frequency of mechanical failures as equipment in the treatment system ages. The PSDs believe most of the maintenance issues that have affected system performance have been properly addressed and improvements in the rate of groundwater recovery are expected, provided groundwater levels do not drop further as a result of the ongoing drought.

### **7.1.3 Opportunities for Optimization**

No opportunities for system optimization were identified during this review. The Site monitoring well network currently provides sufficient data to assess the effectiveness of the groundwater extraction and treatment system. The downgradient area groundwater quality monitoring well network and stream surface water sampling locations currently provides sufficient data to assess the progress of natural attenuation within the downgradient area portion of the Site.

An assessment of the effectiveness of the groundwater capture zone formed within the Upper Black Creek Aquifer by pumping of extraction wells PW-1D, PW-2D and PW-3D was performed for the first five-year remedy review. Findings of that study, which utilized numerical groundwater flow modeling and particle tracking to assess the extent of the capture zone, found that the system was operating as designed. Conditions since that time (groundwater level elevations and extraction well pumping rates) have not varied appreciably, based on a review of monthly pumping records and annual groundwater level measurements. Capture zone development during the remedy review period is therefore believed to have been consistent with remedy design goals. The PSDs will perform an analysis of capture zone development during the next remedy review

### **7.1.4 Early Indicators of Remedy Performance**

Information obtained from the Site inspection, a review of monitoring results, and an evaluation of treatment system operations did not uncover any early indicators that suggest potential forthcoming issues with remedy performance or protectiveness. The groundwater extraction and treatment system continues to operate as designed. During the review period, the groundwater extraction and treatment system experienced occasional failures caused by equipment wear or damage by electrical storms (which are considered normal incidents for a system of this type), but has not shown early signs of severe or escalating operational failures that might be indicative

of adverse changes in groundwater chemistry or flow patterns, undocumented system design or construction flaws, or inadequate inspection and maintenance procedures.

As discussed in Section 7.1.1, pesticide concentration trends observed for groundwater and surface water monitoring locations in the downgradient area during the remedy review period did not yield any early indicators that suggest potential forthcoming issues with remedy performance.

#### **7.1.5 Institutional Controls and Other Measures**

There are no institutional controls in place at the Site in the form of covenants restricting groundwater use on any properties where contamination from the Site has spread above federal or state MCLs.

The PSDs continued to fund the Town of Aberdeen to perform quarterly monitoring of quality for Town Well No. 2 during the remedy review period. Analytical results, which are provided by the Town of Aberdeen to the PSDs, have been non-detect for pesticides during the remedy review period.

The Town of Aberdeen, in a letter dated April 1997, informed US EPA that no new municipal water supply wells would be installed in the downgradient area. No new municipal water supply wells have been installed in the downgradient area since that time.

As stated in Section 7.2.2, the PSDs lease the property on which the Site groundwater and extraction system is located. The lease agreement, which was executed in 1994 for 30 years, places restrictions on the property to prevent its development without the prior consent of the PSDs.

### **7.2 CHANGE ASSESSMENT**

Findings of the Second Five-Year Remedy Review regarding potential changes in the underlying factors that were considered during remedy selection are presented below. These factors included (1) exposure pathways, (2) land use, (3) new contaminants and/or contaminant sources, (4) remedy byproducts, (5) standards, newly promulgated standards and To Be Considered (TBC), (6) toxicity and other contaminant characteristics, and (7) expected progress towards meeting RAOs.

#### **7.2.1 Exposure Pathways**

Exposure pathways at the Site were previously evaluated through an exposure assessment conducted as part of the Baseline Risk Assessment. Two overall exposure conditions were evaluated. The first was the current land use condition, which considered the Site as it existed prior to remedy selection and implementation. The second was the future land use condition, which evaluated potential risks that may be associated with any probable change in Site use and which assumed no RA occurred.

Exposure pathways that were evaluated under current land use conditions included:

- Incidental ingestion of chemicals in on-site and off-site surface soil/sediment by an older child trespasser (8-13 years),
- Dermal absorption of chemicals in on-site and off-site surface soil/sediment by an older child trespasser (8-13 years),
- Inhalation of volatilized surface soil/sediment chemicals by an older child trespasser (8-13 years),
- Inhalation of volatilized surface soil/sediment chemicals by a merchant north of the Site,
- Inhalation of volatilized surface soil sediment chemicals by a nearby child resident (1-6 years) and a nearby adult resident northeast of the Site,
- Inhalation of chemicals in wind blown dust particles by a nearby child resident (1-6 years) and a nearby adult resident northeast of the Site.
- Inhalation of chemicals in wind blown dust particles by a nearby merchant north of the Site.

The exposure pathways that were evaluated under future land use conditions were:

- Incidental ingestion of on-site surface soils/sediment by future on-site adult and child (1-6 years) residents and by a future on-site merchant,
- Dermal absorption of chemicals absorbed to surface soils/sediments by future on-site adult and child (1-6 years) residents and by a future on-site merchant,
- Ingestion of groundwater by future on-site adult and child (1-6 years) residents and by a future on-site merchant,
- Inhalation of volatile organic chemicals while showering with groundwater by a future on-site adult and child (1-6 years) residents,
- Dermal absorption of chemicals while showering with groundwater by future on-site adult and child (1-6 years) residents, and
- Inhalation of volatilized surface soil/sediment chemicals by future on-site adult and child (1-6 years) residents, and by future on-site merchants.

For ingestion of soil, an exposure frequency of 170 days/year for residents and 120 days/year for merchants was assumed. A merchant was assumed to work 5 days/week, 50 weeks/year (2 weeks subtracted for vacation), minus 9 days for federal holidays and was assumed to spend half of that time outside. Values for adult and child residents were based on 5 days/week during the warmer months, April through October, and 1 day/week during November through March). The exposure duration used was 6 years for a child, 30 years for an adult, and 25 years for a merchant.

For ingestion of groundwater, an exposure frequency of 350 days/year for residents and 241 days/year for merchants was assumed. An ingestion rate of one liter per day was used for a child resident and an adult merchant. An ingestion rate of two liters per day was used for an adult resident.

The Site inspection (Section 6.5) revealed that there have been no substantial changes in exposure pathways during the remedy review period. Contaminated surface soils that posed

potential ingestion and dermal contact risks were removed from the site during in 1996 as part of the remedy and replaced with clean fill, thereby eliminating the potential soil ingestion, dermal contact and inhalation risk concerns evaluated under the current (i.e. pre-remedy) land use and future land use scenarios. The Site inspection also revealed that there are no users of groundwater at the Site.

### **7.2.2 Land Use**

There have been no substantial land use changes at the Site during the remedy review period. The property containing the former pesticide warehouse and the groundwater extraction and treatment system has not been developed and is subject to a long-term lease agreement held by the PSDs that restricts any development that might affect the remedy. Occasional harvesting of long-leaf pine needs occurs at the property, which is permitted by the lease agreement.

The property containing the former pesticide warehouse and the groundwater extraction and treatment system continues to be surrounded by light retail/commercial development on the north side of Hwy. 211, residential development and forested land to the east of Domino Drive, rural residential properties to the south, and light commercial development to the west.

Land use patterns in the area downgradient of the former pesticide warehouse, which includes portions of the residential and business districts in the Town of Aberdeen, have not substantially changed during the remedy review period.

### **7.2.3 New Contaminants and/or Contaminant Sources**

No new contaminants (CERCLA hazardous substances or pollutants) or Site-related contaminant sources have been identified during the remedy review period.

### **7.2.4 Remedy Byproducts**

There are no unanticipated toxic byproducts produced at the site as a result of the remedy. No Resource Conservation and Recovery Act (RCRA) hazardous waste streams have been generated during the remedy review period as the result of remedy-related operations. Ongoing groundwater extraction and treatment operations produce approximately six 55-gallon drums of spent granular activated carbon per year. The spent carbon drums are returned to the carbon vendor for regeneration.

### **7.2.5 Standards, Newly Promulgated Standards and To Be Considered (TBC)**

In the preamble to the final NCP, EPA states its policy that it will not reopen remedy selection decisions contained in RODs unless a new or modified requirement calls into question the protectiveness of the selected remedy (55 FR 8757, March 8, 1990). In keeping with EPA policy on the performance of five-year reviews, this report therefore researched potential changes to ARARs or TBCs that were identified in the 1992 ROD that may have occurred since the ROD to determine if such changes might have bearing on the protectiveness of the selected remedy.

Section 121 (d) (2) (A) of CERCLA specifies that Superfund remedial actions must meet any federal standards, requirements, criteria, or limitations that are determined to be legally ARARs. ARARs are those standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstance at a CERCLA site. TBC criteria are nonpromulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary level of cleanup for protection of human health or the environment. While TBCs do not have the status of ARARs, EPA's approach to determining if a RA is protective of human health and the environment involves consideration of TBCs along with ARARs.

Chemical-specific ARARs are specific numerical quantity restrictions on individually listed contaminants in specific media. Examples of chemical-specific ARARs include the MCLs specified under the Safe Drinking Water Act as well as the ambient water quality criteria that are enumerated under the Clean Water Act. Because there are usually numerous contaminants of potential concern for any Site, various numerical quantity requirements can be ARARs. The final remedy selected for this Site was designed to meet or exceed all chemical-specific ARARs and meet location- and action-specific ARARs.

Chemical-specific ARARs identified in the selected remedy within the ROD for the ground water at this Site and considered for this Five-Year Review for continued groundwater treatment and monitoring are listed in **Tables 7-2** and **7-3**. The review of ARARs for the groundwater contaminants identified with cleanup goals in the 1992 ROD suggests that one federal standards (i.e., MCLs) and state standards for these contaminants have changed for several COCs, as discussed below:

- The MCL for gamma-BHC was revised from 0.05 µg/L to 0.2 µg/L;
- A MCL for dieldrin was established at 0.0022 µg/L;
- A MCL for endrin ketone was established at 2.1 µg/L; and
- A MCL for toxaphene was established at 0.031 µg/L.

The following ARARs were identified in the 1992 ROD and were evaluated to determine if any changes in their standards or requirements occurred since the ROD, and if yes, whether such changes might have an impact on the protectiveness of the selected remedy:

- Federal ARARs
  - Federal Groundwater Classification – 55 Federal Register (FR) Part 8733
  - Safe Drinking Water Act of 1986, as amended (40 USC § 300), 40 CFR Part 141
  - EPA Regulations on Sole-Source Aquifers – 40 CFR 149.

**Table 7-2: The following Chemical-Specific Groundwater ARARs Pertain to the Groundwater in the Vicinity of the Source Area and the Ongoing Groundwater Extraction and Treatment System**

COCs	Original ARARs from 1992 ROD (µg/l)	Basis for ROD ARARs*	Current ARAR Standard for ROD COC (µg/L)	Source for Current Standards for ROD ARAR**	Are There Changes in the ROD's ARAR Standards?
Aldrin	0.05	CRQL	0.05	CRQL	No
Alpha-BHC	0.05	CRQL	0.05	CRQL	No
Beta- BHC	0.05	CRQL	0.05	CRQL	No
Delta-BHC	0.05	CRQL	0.05	CRQL	No
Gamma-BHC	0.05	CRQL	0.2	15A NCAC 02L/ MCL	Yes
Dieldrin	0.1	CRQL	0.0022	15A NCAC 02L	Yes
Endrin Ketone	0.1	CRQL	2.1***	15A NCAC 02L	Yes
Toxaphene	1.0	NCGWQS	0.031	15A NCAC 02L	Yes

CRQL Contract Required Quantitation Limit  
 µg/l microgram per liter or part per billion (ppb)  
 \* North Carolina State Groundwater Quality Standard (NCAC 15-21 .0200).  
 \*\* 15A NCAC 02L .0202 Groundwater Quality Standards  
 \*\*\* 15A NCAC 02L .0202 Groundwater Quality Standards – Endrin Ketone is included under total “Endrin” → Classifications and Water Quality Standards Applicable to The Groundwaters of North Carolina  
[http://h2o.enr.state.nc.us/admin/rules/documents/WEBversioncomp2Lw-PFOAInterim\\_dec06.pdf](http://h2o.enr.state.nc.us/admin/rules/documents/WEBversioncomp2Lw-PFOAInterim_dec06.pdf). Amended: 12/7/2006.

**Table 7-3: The following Chemical-Specific Groundwater ARARs Pertain to the Groundwater Downgradient of the Source Area**

COCs	ARARs Identified in the 1998 ESD (µg/l)	Basis for ESD ARARs*	Current Standards for ESD ARAR (µg/l)	Source for Current Standards for ESD ARAR*	Are There Changes in the ESD's Identified ARAR Standards?
Alpha-BHC	0.05	CRQL	0.05	CRQL	No
Beta- BHC	0.05	CRQL	0.05	CRQL	No
Delta-BHC	0.05	CRQL	0.05	CRQL	No
Gamma-BHC	0.2	15A NCAC 02L	0.2	15A NCAC 02L/ MCL	No

CRQL Contract Required Quantitation Limit  
 µg/l microgram per liter or part per billion (ppb)  
 \* 15A NCAC 02L .0202 GROUNDWATER QUALITY STANDARDS → Classifications and Water Quality Standards Applicable to The Groundwaters of North Carolina  
[http://h2o.enr.state.nc.us/admin/rules/documents/WEBversioncomp2Lw-PFOAInterim\\_dec06.pdf](http://h2o.enr.state.nc.us/admin/rules/documents/WEBversioncomp2Lw-PFOAInterim_dec06.pdf). Amended: 12/7/2006.

- State ARARs
  - Identification and Listing of Hazardous Waste – 15A NCAC 13A.0006
  - North Carolina Drinking Water Act – General Statutes, Chapter 130A, Article 10
  - North Carolina Water Quality Standards – 15A NCAC 2B
  - North Carolina Groundwater Quality Standards – 15A NCAC 2L.0100, 2L.0200.

On February 10, 1995, the North Carolina Environmental Management Commission approved revised concentration limits for 29 of the groundwater contaminants regulated under 15A NCAC 2L.0100, 2L.0200 (North Carolina Groundwater Quality Standards). The following tables lists all current chemical-specific ARARs identified in either the 1992 ROD or 1998 ESD.

The 15A NCAC 2L standards, which were last amended on December 7, 2006, are based on the use of groundwater for human consumption. Since there are no users of groundwater at the Site or in areas downgradient of the former facility where monitoring results shown residual levels of site-related pesticides to be present in portion of the Upper or Lower Black Creek aquifers, the revisions to the North Carolina Groundwater Quality Standards do not affect remedy protectiveness.

No other changes to ARARs or TBCs that might affect remedy performance were identified.

## 7.2.6 Toxicity and Other Contaminant Characteristics

The Technical Assessment included a review of US EPA's US EPA's IRIS (Integrated Risk Information System) database to determine if the Toxicological Profile for any of the hazardous substances identified in the ROD as COCs have been revised. As indicated in the following summary tables, none of the Toxicological Profiles for the site-related COCs have been revised during the remedy review period.

### 7.2.6.1 Soil

CAS #	Contaminant Name	Last Significant IRIS Revision*
309-00-2	ALDRIN	01/01/1991
319-84-6	ALPHA-BHC	01/01/1991
319-85-7	BETA-BHC	01/01/1991
319-86-8	DELTA-BHC	03/31/1987
50-29-3	DDT (DICHLORODIPHENYLTRICHLOROETHANE)	01/01/1991
57-74-9	ALPHA-CHLORDANE	02/07/1998**
57-74-9	GAMMA-CHLORDANE	02/07/1998**
58-89-9	GAMMA-BHC	03/01/1988
60-57-1	DIELDRIN	01/01/1991
72-54-8	DDD (DICHLORODIPHENYLDICHLOROETHANE)	08/22/1988
72-55-9	DDE (DICHLORODIPHENYLDICHLOROETHYLENE)	08/22/1988

CAS #	Contaminant Name	Last Significant IRIS Revision*
8001-35-2	TOXAPHENE (POLYCHLORINATED CAMPHENES)	01/01/1991
53494-70-5	ENDRIN KETONE	NA***
<p>* Refers to the most recent statement of or change to a toxicity value [R<sub>f</sub>D, R<sub>f</sub>C, slope factor or unit risk], or most recent significant statement of or change to the basis or justification for the conclusions in the assessment as listed in US EPA's IRIS database.</p> <p>** Update to toxicological review for chlordane (CASRN # 12789-03-6).</p> <p>*** Not available in IRIS</p>		

### 7.2.6.2 Groundwater

CAS #	Contaminant Name	Last Significant IRIS Revision
309-00-2	ALDRIN	01/01/1991
319-84-6	ALPHA-BHC	01/01/1991
319-85-7	BETA-BHC	01/01/1991
319-86-8	DELTA-BHC	03/31/1987
58-89-9	GAMMA-BHC	03/01/1988
60-57-1	DIELDRIN	01/01/1991
72-20-8	ENDRIN	10/01/1989
79-01-6	TRICHLOROETHYLENE*	07/01/1989** 09/28/2007***
8001-35-2	CAMPHECHLOR (TOXAPHENE)	01/01/1991
<p>* Trichloroethylene is no longer considered a Site-related Chemical of Concern as documented in a letter dated August 23, 1995 from Giezelle Bennett, U.S. EPA Region 4 to the Geigy Site PSDs, and subsequently noted in the Site Explanation of Significance Difference, Jan. 23, 1998.</p> <p>** Last significant revision date listed on IRIS Substance List.</p> <p>*** Date shown by IRIS Recent Additions indicating updated Toxicological Review for 1,1,1-Trichloroethane.</p>		

### 7.2.7 Expected Progress Towards Meeting Remedial Action Objectives

Remedial action goals for soils were met upon completion of the RA construction activities at the Site. The RAO for the selected groundwater remedy was to restore groundwater to its beneficial use as a drinking water source. Groundwater quality monitoring data collected since the start-up of the Site groundwater extraction and treatment system (see pesticide concentration trend graphs, **Appendix B**) reveal that removal of the former source materials, coupled with operation of the extraction and treatment system, have significantly lowered pesticide concentrations in Site groundwater and brought the remedy closer to this goal. Continued

declines in pesticide concentrations are expected, however, the rate of decline is expected to lessen, which is consistent with typical pump and treat remedies. No other cost-effective groundwater treatment technologies or remediation approaches are known at this time that would offer a significant improvement in the rate of progress towards meeting Site RAOs.

**7.3 OTHER POTENTIAL FACTORS**

**7.3.1 Ecological Risks**

Contaminated soils were removed from the Site during remedy construction in 1996. As such, there are no complete exposure pathways for onsite wildlife as the contaminated soils were removed from the Site. There have been no substantial changes in Site conditions (e.g., increases in groundwater or surface water contaminant concentrations, erosion of surface soils) during the remedy review period that could pose increased risk to potential ecological receptors. Analytical results of annual surface water samples collected from McFarland's Branch and Aberdeen Creek demonstrate that pesticide concentrations are at levels below threshold values previously determined to be protective of potential ecologic receptors, which were presented in Appendix C (Surface Water and Sediment Risk Assessment) of the September 1997 Final Downgradient Groundwater Remedial Action Work Plan (RUST Environment & Infrastructure) are summarized below:

Risk-Based Concentrations for Ecological Receptors for Surface Water*		
Chemical	Long-term RBC**(µg/L)	Short-term RBC***(µg/L)
Alpha-BHC	8	200
Beta-BHC	8	200
Gamma-BHC	0.4	10
Delta-BHC	8	200
* RBCs are presented for aquatic life, which was found to be the most sensitive ecological receptor group.		
** Long-term RBCs are based on chronic aquatic toxicity data.		
*** Short-term RBCs are based on acute chronic toxicity data.		

The Site does not support extensive wildlife populations, given its small size, the limited diversity of the vegetative community, and the availability of higher quality habitat in adjacent areas. Resident vertebrate species of the Site are limited to small mammals such as rabbits, voles and field mice. Some avian species and reptiles (terrapins, snakes and lizards) also visit the Site. Other wildlife species, such as white tailed deer, occasionally use the Site while foraging.

**7.3.2 Natural Disaster Impacts**

The Site has not been affected by natural disasters during the remedy review period. Additionally, there have been no substantial changes in Site conditions (e.g., contaminant types,

exposure pathways, potential receptors, development, vegetative cover, etc.) that could render the Site more susceptible to potential natural disaster related impacts (e.g., flooding, erosion, fire, wind damage).

### 7.3.3 Other Remedy Protectiveness Information

The Aberdeen Contaminated Ground Water site, which is located east of the Geigy site, has been finalized on the NPL. TCE is a groundwater contaminant associated with the Aberdeen Contaminated Ground Water site. Because of its close proximity and its location in an area that is hydraulically upgradient of the Geigy site, the Aberdeen Contaminated Ground Water site may be an off-site groundwater contaminant source and therefore was included by this report as another potential factor in the technical assessment of remedy performance. At this time, the proposed addition of the Aberdeen Contaminated Ground Water site is not anticipated to affect the protectiveness of the Geigy site remedy, however, as noted in Section 8.1, potential impacts to the Geigy site remedy will not be known until the RI at the Aberdeen Contaminated Ground Water site has been completed.

## 7.4 SUMMARY OF TECHNICAL ASSESSMENT

This section summarizes discussions regarding the three questions presented at the beginning of Section 7.0.

### **Question A: Is the remedy functioning as intended by the Decision Documents?**

Yes. Based on the pesticide concentration trends discussed in Section 7.1 (refer to **Appendix B**), ongoing operation of the Site groundwater and treatment system is making progress towards restoring groundwater to its beneficial use as a drinking water source. As of this review, the groundwater remedy is 10 years into the 30 year performance period estimated by the ROD. The BHC concentrations, and the rates at which they are decreasing as a result of groundwater extraction and treatment as well as natural attenuation, appear to be consistent with the remedy performance and timeframe expectations that led to Alternative 3 (recovery and treatment of all Site groundwater exceeding groundwater remediation levels using carbon absorption) as the selected remedy. Additionally, ongoing operation of the groundwater treatment system is providing source control for the MNA component of the remedy, which was defined through an ESD.

Groundwater and surface water quality monitoring results obtained for the MNA component of the remedy indicate that Site-related pesticide concentrations in the area that is hydraulically downgradient of the site continue to decline and are protective of potential receptors. Quarterly drinking water quality monitoring of Town Well No. 2 continues to verify that site-related conditions in the downgradient area have not impacted this drinking water source.

As noted in the Recommendations and Follow-Up Actions section of this report, the PSDs will conduct monthly visual (windshield) surveys of all areas of the groundwater plume of

contamination above cleanup goals set in the ROD, and in areas where the plume is anticipated to move, to determine whether offsite properties are using groundwater for drinking water or other purposes. The PSDs will also submit a map to the Director of the Town of Aberdeen Public Works Department showing the downgradient area of interest and will periodically contact the Director to determine if any offsite properties are using groundwater for drinking water or other purposes.

**Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used the time of remedy selection still valid?**

Yes. Based on the information presented in Section 7.2, the principal assumptions and conditions evaluated during development of the ROD, and used to select Groundwater Remediation Alternative 3 (groundwater recovery to attain remediation levels) as the most appropriate remedy for Site groundwater, are still valid. The Site inspection revealed that there have been no substantial changes in exposure pathways or land use patterns during the remedy review period. The technical assessment found no indications of new contaminants, new contaminant sources, or unanticipated remedy byproducts. The assessment did not find changes in applicable regulatory standards or technical updates on toxicity characteristics of site-related contaminants that could affect the remedy.

Similarly, the principal assumptions and conditions evaluated during development of the ROD, and used to select Soils Remediation Alternative 2 (excavation and off-site disposal of soils exceeding remediation levels and demolition of the warehouse foundation) as the most appropriate remedy for Site soils, are still valid.

**Question C: Has any other information come to light that could call into question the protectiveness of the remedy?**

No. Based on the information presented in Section 7.3, there have been no substantial changes in Site conditions that could pose increased risk to potential ecological receptors and there have been no natural disaster impacts at the site that could call into question the protectiveness of the remedy.

## 8.0 ISSUES

Table 8-1 summarizes the four (4) issues identified during this first five-year review effort.

<b>Table 8-1: Issues Identified During Second Five-Year Review</b>		
<b>Issue</b>	<b>Currently Affects Protectiveness (Y/N)</b>	<b>Affects Future Protectiveness (Y/N)</b>
<b>Institutional Controls</b> – Restrictive covenants, well drilling ordinances, or other enforceable institutional controls that prevent the installation of a potable well are needed for properties impacted by contaminated groundwater.	No	Yes
<b>Re-Evaluate Timeframe to Achieve Groundwater Performance Standards</b> – Update/Revise modeling efforts as well as the MNA evaluation presented in the October 1997 <i>Downgradient Groundwater Remedial Action Work Plan</i> .	No	No
<b>Re-Evaluate Capture Zone Analysis for both the surficial and Upper Black Creek aquifer groundwater extraction systems</b> – Update/Revise effort conducted as part of the 2003 Five-Year Review process.	No	Yes
<b>Revise Monthly Inspection Report Form</b> – Revise reporting form to capture observations/conclusions made during the monthly visual (windshield) survey of all areas of the groundwater plume of contamination above cleanup goals set in the ROD, and in areas where the plume is anticipated to move, to determine whether offsite properties are using groundwater for drinking water or other purposes.	Yes	Yes

**9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS**

The remedy is functioning as planned at this time. However, **Table 9-1** identifies four (4) recommendations.

**10.0 PROTECTIVENESS STATEMENTS**

The remedy at the Site is expected to be protective of human health and the environment upon attainment of groundwater cleanup goals noted in the 1992 ROD as amended through the 1998 ESD, through continued MNA and groundwater pump and treatment. The selected remedy at the Site is protective of human health and the environment in the short term, because all exposure pathways that could result in unacceptable risks are being controlled.

However, in order for the remedy to be protective in the long term, the following actions need to be taken: restrictive covenants, well drilling ordinances, or other enforceable institutional

controls that prevent the installation of a potable well must be implemented at properties impacted by contaminated groundwater above the groundwater cleanup goals for Site related COCs.

#### **11.0 NEXT REVIEW**

The next five-year review for the Geigy Chemical Corporation Site is required by September 2013, five years from the approval date of this review.

<b>Table 9-1: Recommendations and Follow-up Actions</b>						
<b>Issue</b>	<b>Recommendations/Follow-Up Actions</b>	<b>Party Responsible</b>	<b>Oversight Agency</b>	<b>Milestone Date</b>	<b>Affects Current Protectiveness? (Yes/No)</b>	<b>Affects Future Protectiveness? (Yes/No)</b>
<b>Institutional Controls</b>	Prepare Institutional Controls Implementation Plan – This plan should describe the approach for placing restrictive covenants, well drilling ordinances, or other enforceable institutional controls that will prevent the installation of a potable well on a property which overlies the plume where Site related COCs exceed specified performance standards.	PRPs	EPA/NCDENR	September 30, 2010	No	Yes
<b>Re-Evaluate Timeframe to Achieve Groundwater Performance Standards</b>	Update/Revise modeling efforts in calculating timeframes to achieve groundwater performance standards as well as the MNA evaluation presented in the October 1997 <i>Downgradient Groundwater Remedial Action Work Plan</i> .	PRPs	EPA/NCDENR	September 30, 2013 (to be incorporated in next Five-Year Review Report)	No	No
<b>Re-Evaluate Capture Zone Analysis</b>	Re-Evaluate Capture Zone Analysis for both the surficial and the Upper Black Creek aquifer groundwater extraction systems which was last done as part of the first Five-Year Review process.	PRPs	EPA/NCDENR	September 30, 2013 (to be incorporated in next Five-Year Review Report)	No	Yes
<b>Revise Monthly Inspection Report Form</b>	Revise monthly inspection reporting form to capture observations/conclusions made during the monthly visual (windshield) survey of all areas of the groundwater plume and in areas where the plume is anticipated to move, to determine whether offsite properties are using groundwater for drinking water or other purposes (refer to Section 7.4).	PRPs	EPA/NCDENR	November 30, 2008	Yes	Yes

**Appendices for this Five-Year Review are available by placing a request using the Customized CERCLIS/RODS Report Order Form.**

**<http://www.epa.gov/superfund/sites/phonefax/rods.htm>**